LESSON 3

Living in Water: Dwarf African Frogs

Overview and Objectives

In this lesson, students are introduced to the first of their three animals: the dwarf African frog. By creating frog habitats and identifying the living and nonliving elements in them, students deepen their awareness of the many variables that affect an animal's survival. As they place the frogs in classroom habitats far from their natural homes, students begin to understand that they are now responsible for meeting many of the animals' needs. In addition, by beginning a log in which to record observations of behavior over time, students begin to appreciate the importance of ongoing observation—a basic process scientists use in studying animals.

- Students review the living and nonliving elements necessary to the dwarf African frog's habitat.
- Student groups create a habitat for the dwarf African frog and record all the elements in it.
- The class discusses frog care and feeding schedules.
- Students observe their frogs and record questions about them.
- Students discuss what kinds of observations might be recorded in an animal log.
- Students discuss the purpose of an animal log and create an animal log checklist.

Background

The three animals in this unit were selected because of their diversity of structure, behavior, and habitat. When compared in later lessons, the three animals illustrate a variety of animal adaptations associated with food getting, movement, body structure, and protection. This lesson introduces the first animal: the dwarf African frog. Living exclusively in water, this frog is often called the "aquarium frog" because of its wide use by aquarium hobbyists.

Frogs are vertebrates (animals with backbones) and belong to the amphibian group. The word "amphibian" comes from a Greek word meaning "double life" (most amphibians spend part of their life in water and part on land). Amphibians were the first vertebrates on land and were dominant for more than 100 million years. The main characteristics of most amphibians are the following:

- Their skin is thin, moist, and without scales. Amphibians can take in oxygen from water and air directly through their skin.
- Their skin needs to be moist for skin respiration.

- They hatch from unshelled, moist eggs and undergo metamorphosis. Frogs, for example, hatch as tadpoles, which develop into juvenile toadlets or froglets.
- They are cold-blooded. Amphibians' body temperatures change along with the temperature of their surroundings.
- They molt (shed their skin).
- Some can change shade. Pigment-changing cells **(chromatophores)** are responsible for shade change. Changes in the amphibian's lightness or darkness can depend upon temperature, light, or wetness. For example, in cool temperatures the chromatophores spread out, and the amphibian becomes darker. In warm temperatures, chromatophores contract and the amphibians become lighter. Some amphibians change from one color to another.
- In extreme cold, they **hibernate** (become inactive or dormant) on land or in mud at the bottom of lakes and ponds. In extreme heat, they **estivate** (slow down their body processes) in cool mud.

Frogs inhabit a variety of habitats, from near the Arctic Circle to tropical rain forests. Most of the approximately 2,500 kinds of frogs are tropical. Frogs' bodies are specially adapted for jumping. They have no tail, few vertebrae, long hip bones, and a shoulder structure built for shock landings.

The Dwarf African Frog

The dwarf African frog *(Hymenochirus boulengeri)* is a member of the group of frogs known as the **pipids.** All pipid frogs are totally aquatic and, unlike most frogs, lack tongues and moveable eyelids.

Body Structure

The dwarf African frog (Figure 3-1) grows only to about 4 cm (about 1½ in). Its natural habitat is a lake or pond in the forests of Zaire and the lower Congo in Africa. Its body is somewhat flat and it has a small pointed head. Its back is brownish with dark spots; its abdomen is light. In addition, the frog has a lateral line system of nerve endings running from its head down the side of its abdomen. This system (also present in fishes) enables the frog to sense any movement in the water around it.

The frog's toes are webbed, and the inner three toes of the hind limbs are clawed. The frog's eyes are small and without lids. Its nostrils are large, and its mouth is toothless. Frogs do not have external ear flaps as humans do, but, like humans, they hear through a tympanic membrane.

The dwarf African frog has a limited ability to lighten and darken its color to match its surroundings. This coloring acts as good camouflage when frogs hide among plants and rocks or search for food. Students may observe frogs shedding their skin. Frogs often eat the shed skin to get protein.

Feeding Behavior

Frogs feed mostly on aquatic invertebrates (crustaceans, worms, and insects) and mainly as a response to a visual stimulus such as movement. Because the frog's eyesight is better above than in front of its snout, it will feed on food that is not moving only if its snout has been touching the food for some time. Your class will feed the frogs dried bloodworms and flake food—both nonmoving.

Students will observe the frog snapping at food at the water's surface. The frog will also search for food along the bottom of the tank, where it will use its down-pointed snout and front feet to push stones aside to locate food. The frog lunges

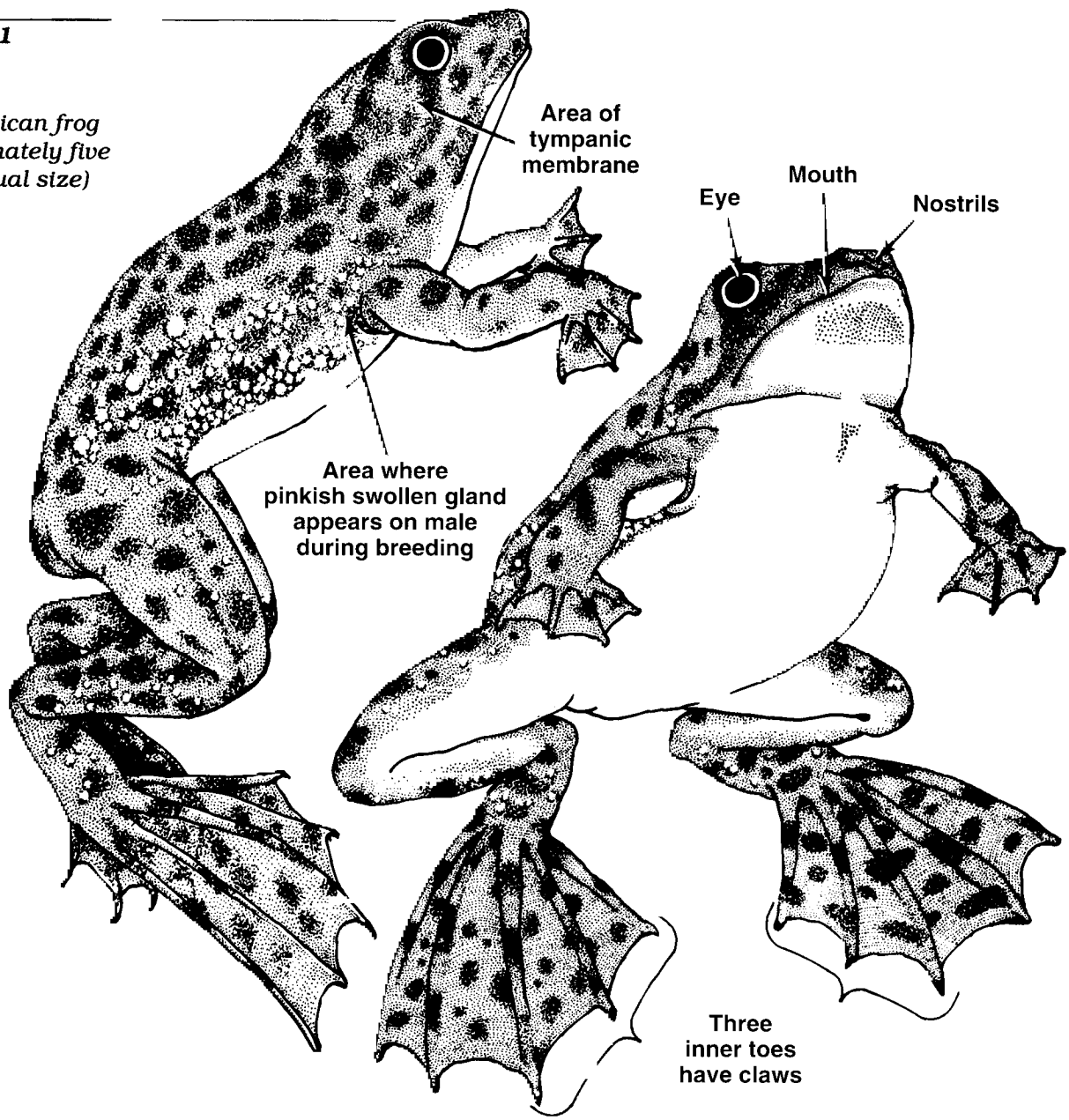
at its prey and sweeps it into its mouth with its front feet. With its back and front feet, the frog often tears larger food before swallowing it.

In the post-metamorphic stage, all frog species breathe through lungs that take oxygen from the air. Students will observe in the dwarf African frog an interesting behavior called **burbling,** the expiration and inspiration of air at the water's surface. In addition to taking in some oxygen from the water through its skin, the frog also can breathe atmospheric air through the lungs by surfacing to burble. The frog floats parallel to the surface, arms and legs extended and spread apart, snout protruding from the water, and rapidly and silently pulsates its throat. As the frog burbles quickly, it moves up and down in the water.

Note: Students will be creating their own animal drawings. It is recommended that you not show the animal illustrations in the Teacher's Guide until after completing Lesson 13.

Figure 3-1

Dwarf African frog (approximately five times actual size)



Breeding Behavior

Many students will ask how to distinguish between male and female frogs. This is difficult. In general, female dwarf African frogs are larger and stouter than males. During breeding, males develop pinkish swollen glands behind their forelimbs. Successful breeding in captivity is rare, and it is highly unlikely to occur during the course of this unit. If the tank water in your classroom is warm (about 25°C, or 76°F), however, the frogs may try to breed after a few months. In nature, the male's vocalizations attract a female and stimulate her ovulation. As with other frogs, the male's call attracts only females of the same species and so helps prevent mating between species. During mating, the male clasps the female around the pelvis. The female lays eggs on the water's surface. After five days, larvae hatch, attach to the tank and plants, and swim freely to feed. If your frogs breed, you will need to move the eggs to another tank so that the adults do not eat them.

In this lesson the students review their frog habitat proposals from Lesson 2. This lesson's **Materials** section outlines the exact materials students will use to create the frog habitat. However, most elements the students included in their proposals can be equated with the ones on the list. They are as follows:

Elements of the Natural Habitat	**Elements of the Classroom Habitat**
Fresh water	Dechlorinated tap water
Space to live in	A tank that defines the space
Plants	Elodea
Food	Dried bloodworms and flake food
Rocks, soil	Gravel
Light	Natural light through windows
Air	Dissolved oxygen in water and air in classroom

Students can best observe an animal's general behavior over a period of time. To help them in their efforts, students will establish an animal log in which to record daily observations. The checklist you create in this lesson will remind students of the most important behaviors to keep observing. Figure 3-2 shows one example of an animal log checklist.

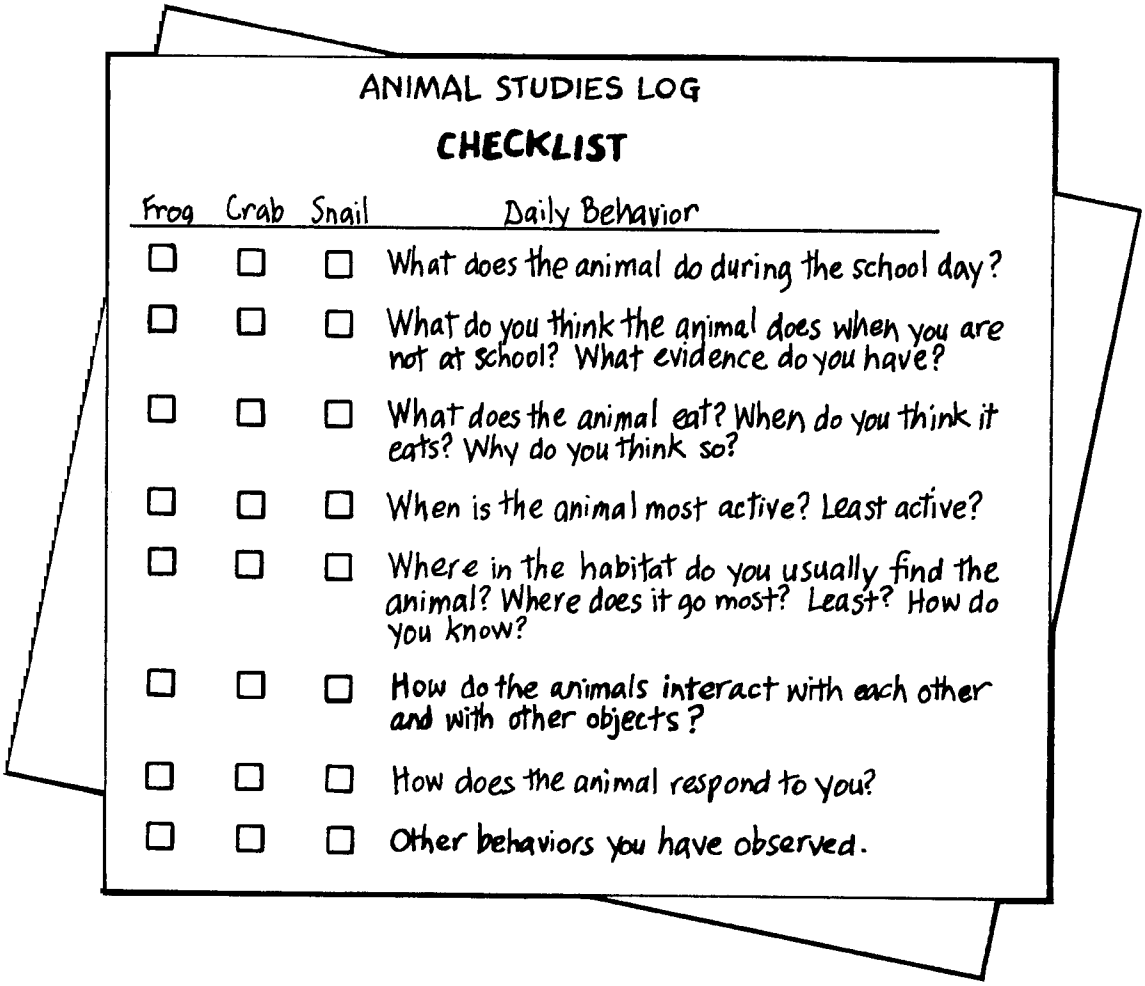
It would be unrealistic to expect your students to observe and record all the animal characteristics discussed in the **Background** sections of this guide. Many characteristics are not obvious to children, for whom learning to observe and record is an ongoing process. Even if you are tempted to share with students information that may not be easily observable, instead encourage them to learn about each animal through their own experiences. In Lesson 14, the reading selection "Did You Discover . . .?" will give students information on the animals that they are unlikely to observe firsthand.

Management Tip: Studying live animals involves care and maintenance. With a little training, fourth-graders are capable of handling most of the work. Some teachers schedule specific times during the day to tend to the animals. Establishing a routine and fostering students' independence can add greatly to their experiences in this unit. Caring for the animals will also help your students develop sensitivity to living things. To encourage sensitivity, discuss some guidelines for studying animals such as the following:

- Keep the covers on the habitats.
- Do not bang on the habitats or disturb the animals.
- Be gentle with the animals at all times.

Figure 3-2

Sample checklist



ANIMAL STUDIES LOG

CHECKLIST

Frog	Crab	Snail	Daily Behavior
☐	☐	☐	What does the animal do during the school day?
☐	☐	☐	What do you think the animal does when you are not at school? What evidence do you have?
☐	☐	☐	What does the animal eat? When do you think it eats? Why do you think so?
☐	☐	☐	When is the animal most active? Least active?
☐	☐	☐	Where in the habitat do you usually find the animal? Where does it go most? Least? How do you know?
☐	☐	☐	How do the animals interact with each other and with other objects?
☐	☐	☐	How does the animal respond to you?
☐	☐	☐	Other behaviors you have observed.

Materials

For each student

- 1 pencil
- 1 science notebook
- 1 hand lens
- 1 copy of the **Animal Log Checklist** (blackline master on pg. 49)

For every two students

- 1 dwarf African frog

For every four students

- 1 plastic cup, 270 ml (9 oz) and lid
- 1 plastic flex tank, 3.8 liters (1 gal) and lid
- 4 elodea sprigs
- 1 china marker
- 1 metric ruler
- 1 plastic cup, 60 ml (2 oz) and lid
- 1 plastic teaspoon
- 1 piece of notebook paper
- 1 pail of conditioned tap water

For the class

- 2 holding pails (each with half the elodea and half the frogs)
- 1 bucket for holding rinsed gravel
- 1 plastic cup, 270 ml (9 oz), for scooping gravel
- 3 2.3-kg (5-lb) bags of aqua gravel
- 1 bottle of tap water conditioner, 60 ml (2 oz)
- 8 plastic pails, 2.8 liters (3 qt)
- 2 aquarium dip nets, 5 cm (2 in)
- 1 "Frogs" class list (from Lesson 1)
- 2 sheets of newsprint
- 1 box of flake fish food, 20 g (.7 oz)
- 1 box of dried bloodworms, 8 g (.28 oz)
- 1 green permanent marker
- 1 black permanent marker
- 1 Post-it™ notepad, 51 × 76 mm (2 × 3 in)
- 1 aquarium thermometer
- Frog habitat proposals (from Lesson 2)
- Markers
- Paper towels
- Sponges
- Masking tape
- Overhead projector (optional)

Preparation

1. When the frogs and plants arrive, refer to Appendix A.
2. Have student helpers use the green permanent marker to mark dots either directly on the following materials or on masking tape labels for them: eight large plastic cups and lids, pails, plastic spoons (handles), aquarium dip nets (handles), and small cups and lids. The green dots will distinguish the frog-related materials from the crab-related materials, which will have orange dots.
3. Have student helpers
   - Rinse the gravel in a colander or pail with tap water until the water runs clear. Place the rinsed gravel in a container along with a plastic cup for scooping.
   - Rinse each plastic tank with warm water (students should not use soap).
4. Have student helpers fill eight pails three-fourths full with water, add a drop of tap water conditioner to each, and stir with a clean spoon.
5. Set up a distribution center for tanks and lids, rulers, china markers, pails of water, large cups with lids, small cups with lids, and paper towels (see Figure 3-3). Keep the aquarium nets, flake fish food, dried bloodworms, frogs, and water plants separate from the distribution center but easily accessible.
6. Label a newsprint sheet "What We Would Like to Know about Our Frogs." Have this and the Post-it™ notes on hand.
7. Prepare and hang newsprint containing the first circle of an animal habitat Venn diagram. It will be used in Lesson 9 (see Figure 3-4). Refer to Teaching *Animal Studies*, pg. 9, for information on using Venn diagrams.

Figure 3-3

Distribution center

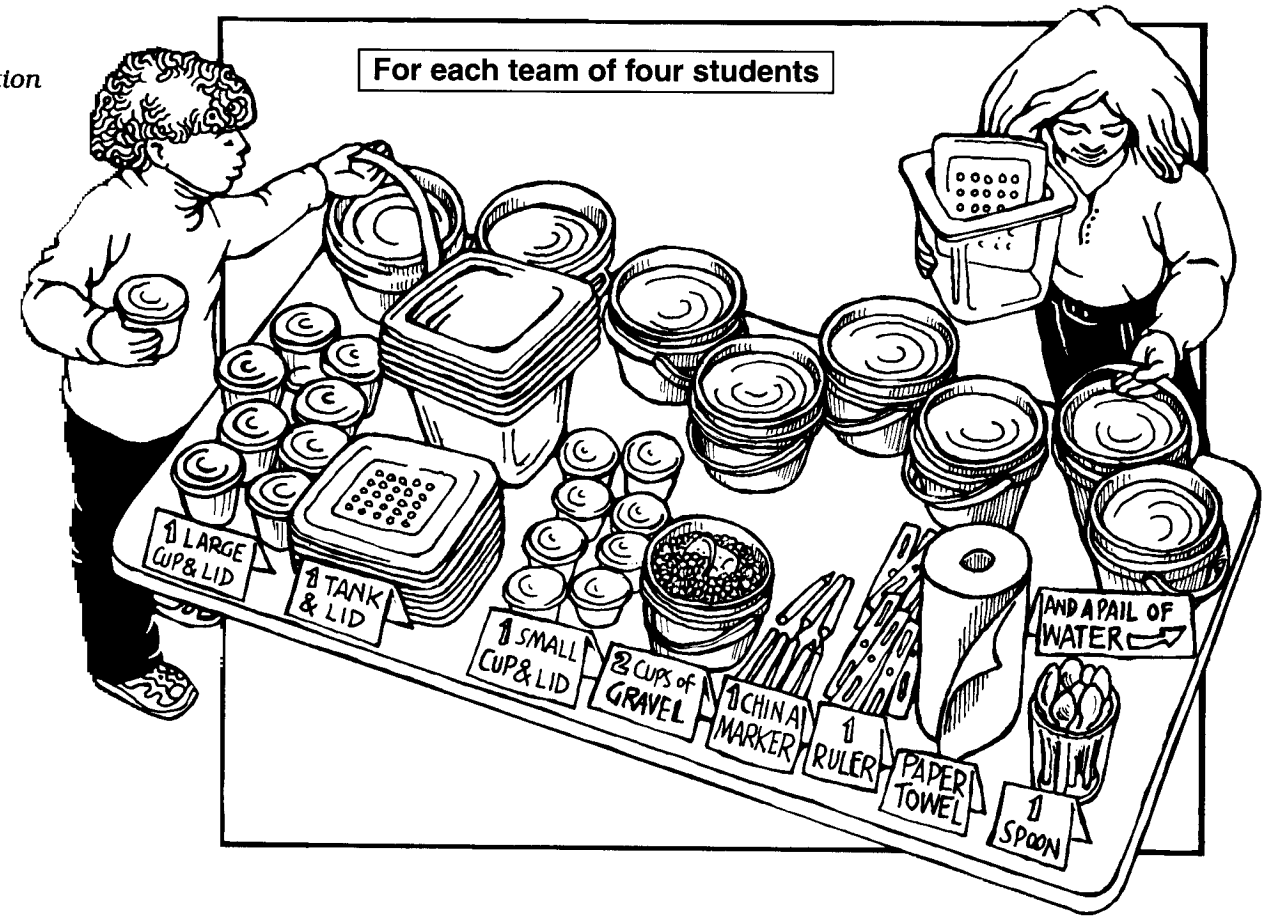


Figure 3-4

Elements of the frog habitat

8. If your classroom has no water source, identify a nearby one. Or use a jug to bring water into the room.
9. Arrange students in their groups from Lesson 2.
10. For the completed frog habitats, choose a storage area in indirect light and away from heat and drafts. Make sure the habitats are accessible to students for daily observation.
11. Copy the **Animal Log Checklist** on pg. 49 for each student. Make an overhead of it for class use.

Management Tip: You will need storage space for two more kinds of animal habitats. If your students' desks are arranged in groups, try to keep one or more habitats in the center of these desks for ongoing observation.

Procedure

1. Focus students on their frog habitat proposals from Lesson 2. In a class discussion, ask students to review the important elements of the frog's home.
2. Explain that you have in the room materials for creating part of a water environment, called a habitat, in which the dwarf African frog can get what it needs to live. Show the class the tanks, gravel, plants, frog food, and pails of dechlorinated water. Challenge students to equate these materials with the elements in their frog habitat proposals.
3. Remind students that the frog must get the right amount of each material in its home. Review the **Student Instructions for Building a Dwarf African Frog Habitat,** on pgs. 47–48 (pgs. 14–15 in the Student Activity Book), with the class. Help each group decide who will assume the duties of moderator, recorder, investigator, and reporter. Remind them that the moderator's job is to make sure that each group member helps get materials and create the habitat.

Management Tip: Before starting to build the habitats, some groups have found it helpful for each member to record his or her name by each step of the instructions for which he or she is responsible.

4. Guide students through the process of getting the materials from the distribution center. Explain that moderators should let you know when the group is ready for the plants, which you will hand out on a paper towel. When the habitat is complete, you will give students their frogs.
5. Have the groups get their materials and begin. Let students know that when they need gravel, they will go to the distribution center to scoop two cups of gravel for the tank. As the groups create their frog habitats, be sure the recorders list the living and nonliving elements they place in each tank.
6. When the group moderators tell you their habitats are complete, carefully net two frogs and add the frogs to each habitat. Remind groups to begin their observation of the frogs while you distribute the rest.
7. Ask groups to set aside the small plastic cups, lids, and spoons, and return all other materials to the distribution center.
8. Ask students if they think the frogs have what they need to survive in the classroom. If food is not mentioned, ask the class what they think the frogs might eat. Then display the flake food and dried bloodworms and talk about why it would be difficult to provide live food, such as insects and worms. Have each group fill a small cup halfway with a mixture of flake food and dried bloodworms. Assign each group a letter and have students use the

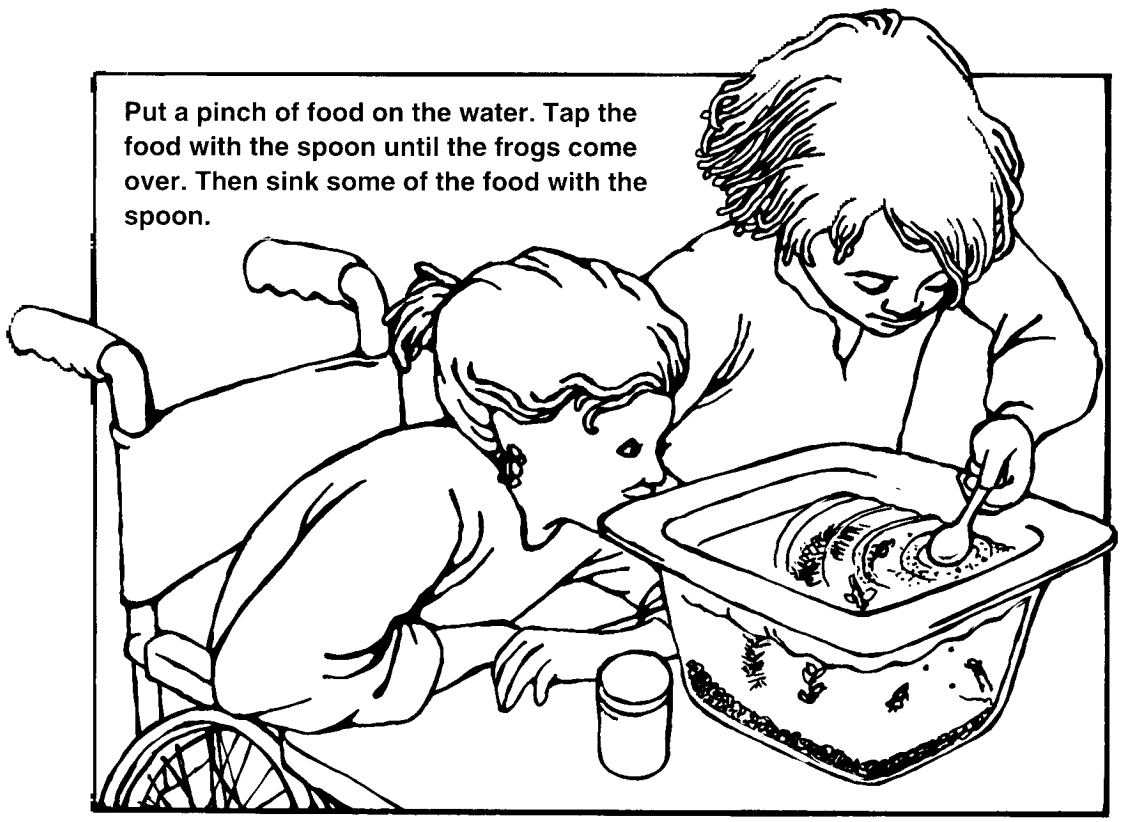
black marker to code their habitats, cups, lids, and spoons by writing that letter on the green dots. Store the food near each group's frog habitat.

9. Using Figure 3–5 as a guide, demonstrate to groups how to feed the frogs. Refer students to Figure 3–2 in their books.

   Note: Have students continue to feed the frogs this way. The frogs will eventually respond to the food without the spoon. Students will probably need to refill their food cups over the course of the unit.

Figure 3-5

How to feed the frogs



10. Invite groups to share their observations of feeding the frogs. Ask questions such as the following:

    - What happened when you put food in the tank?
    - Did both frogs respond to the food? What happened when you moved the food with the spoon?
    - How much food did the frogs eat?
    - Did the frogs eat from the surface or bottom of the habitat?

    Let students know that each time they feed the frogs over the next few weeks, they should observe the feeding carefully and discuss these questions again.

11. Now focus the class on the circle you have prepared for the Venn diagram. Remind students of their list of living and nonliving elements in the school. Explain that now you want to create a similar list for the frog habitats. Ask group reporters to share their lists, and record each element on the Venn circle. Save this for use in a later lesson.

12. Discuss frog care with the class. Be sure to cover the following points:

- Feeding schedule. The frogs should be fed one or two times a day. If there is still food visible at the time of the second daily feeding, skip a feeding. If food is still in the tank the next day (indicating overfeeding) remove it with the spoon to avoid water contamination and have students reduce the amount of food. Occasionally, food may stick to the floating elodea. Students can remove the elodea, rinse it with clean water, and put it back in the tank. Some students have enjoyed creating a feeding and habitat cleaning schedule for their group (see Figure 3-6).

Figure 3-6

Sample feeding and cleaning schedule

Frogs

	Monday	Tuesday	Wednesday	Thursday	Friday
Feed	Maddy 9:00 a.m. and 2:30 p.m.	Katie 9:00 a.m. and 2:30 p.m.	Maddy 9:00 a.m. and 2:30 p.m.	Faith 9:00 a.m. and 2:30 p.m.	Katie 9:00 a.m. and 2:30 p.m.
1. Clean elodea 2. Check for old food 3. Check water level	Katie 2:00 p.m.		Faith 2:00 p.m.		Maddy 2:00 p.m.
Add new water every other week.					

- Water. Have two pails of conditioned water available each day. Every two weeks, have the groups use the large green-dotted plastic cups to carefully remove two old cupfuls of water from the tanks and replace it with two fresh cupfuls (see Figure 3-7).

  Use the thermometer to monitor the water temperature. The ideal temperature for the frogs is between 25°C and 30°C (77°F and 86°F).The frogs can stand some fluctuations in temperature. If the water in the habitats is consistently cooler than 20°C (68°F), move the habitats to a warmer location.

  If the water in a habitat is very cloudy or an algae bloom has occurred, empty the tank water. Then have students put their frogs and plants in a holding pail of conditioned water while they clean the frog habitat. Be sure they rinse the gravel and use a clean paper towel to remove any algae on the sides of the tank. Students can then rebuild the habitat.

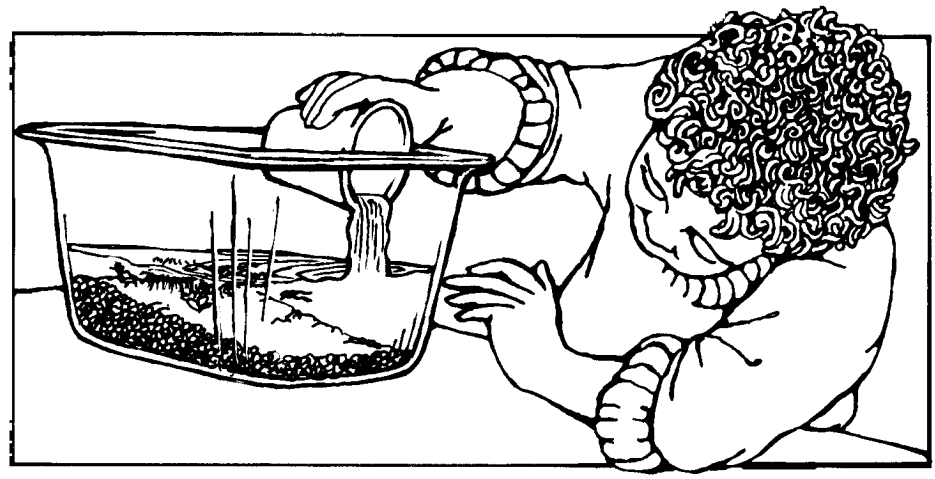
- Habitat placement. Place habitats in indirect light and away from excessive heat and drafts.

- Extra frogs. Because of illness or trauma during shipping, a frog may die soon after arrival. Keep extra frogs in a pail with a plant or two, or have students create an extra habitat. Assign students to care for these as well.

See Appendix A for additional maintenance information.

Figure 3-7

Replacing water in frog tanks



Final Activities

1. Remind students that in Lesson 1 you recorded what they knew about frogs. Explain that today you would like to know what questions they have about frogs—specifically, the dwarf African frog. Distribute Post-it™ notes to students. Ask them to write questions, initial the notes, and stick them on the newsprint you labeled "What We Would Like to Know about Our Frogs." Encourage students to add new questions as they study the frogs.

2. Distribute a copy of the **Animal Log Checklist** to each student and set up the overhead projector. Ask questions such as the following:

   - When do you think people would want to record observations about an animal?
   - What are some ways observations could be recorded?

   Let students know that a log is a type of journal that contains detailed observations about one subject. Today, students will set up in their notebooks an animal log for the frog. Later, they will set up logs for the crab and snail.

3. Explain that students will create a list of questions to help them know what to record in their logs about each animal. Invite students to brainstorm general behaviors they might observe, such as feeding behavior. Start the list by asking a question about feeding behavior, such as "When and how does the animal eat?" Have students write the questions on their log checklists as you write them on the overhead or the board. Your class needs to generate at least five questions (see Figure 3-2).

4. Have students create a section in their notebooks for the animal log and attach the checklist to the front of that section. Ask them to title the first page in the section "Frog." Have students silently observe the frogs for a short time. Then ask the class to look at the checklist and decide which questions they may be able to answer about the frog. Help students record their observations in the log and check the box next to the frog question they have now answered. Explain that checking off the boxes helps them remember the questions for which they have already recorded some observations in the log and the questions they still need to address. Let students know that they can continue to add their own questions about each animal to the list.

   Note: To help students get used to using the log checklist, periodically revisit it as a class.

Extensions

SCIENCE

1. Challenge students to research the similarities and differences between toads and frogs.

MATHEMATICS SCIENCE

2. Ask students to use a Venn diagram to compare the frog's classroom habitat with its natural habitat.

SOCIAL STUDIES SCIENCE

3. Have students locate the Congo and Zaire on a map. Then have them research what other kinds of frogs, as well as other kinds of plants, are found in the lakes and ponds of Central Africa.

LANGUAGE ARTS SCIENCE

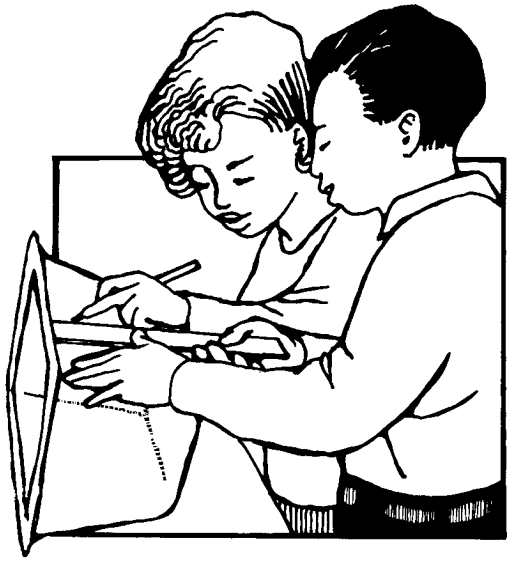
4. Many animals, such as the cat and dog, have been domesticated. Have students research early dogs' *(Canis familiaris)* and cats' *(Felis catus)* natural habitats. Expand this to other pets such as gerbils. Have students compare each animal's natural habitat with the homes they have made for their pets.

LANGUAGE ARTS SCIENCE

5. Share books with the class about the life of a frog, such as *The Complete Frog,* by Elizabeth A. Lacey (see Bibliography).

Student Instructions for Building a Dwarf African Frog Habitat

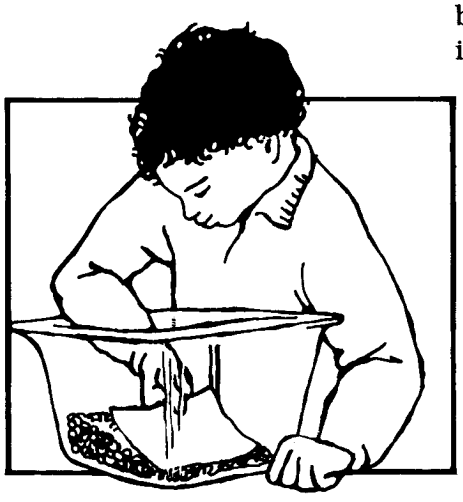
1. Use a china marker to write the names of your team members near the top of the tank. This will be the front of your habitat.



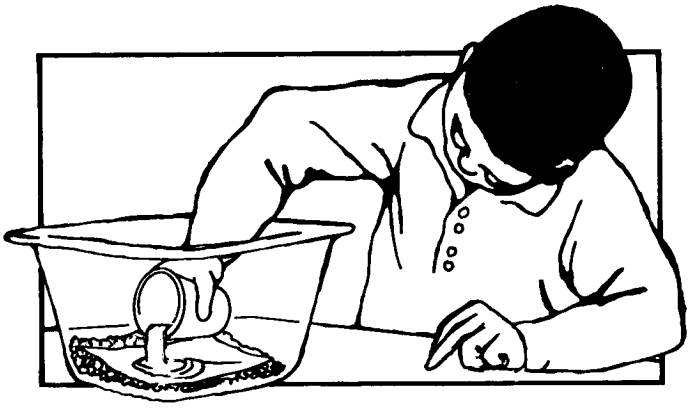
2. Now use the china marker to mark a waterline 2.5 cm (1 in) below the top of the tank.

3. Add two cups of gravel.

4. Slope the gravel so the high end is in the back and the low end is in the front.



5. Cover the gravel with a piece of notebook paper.

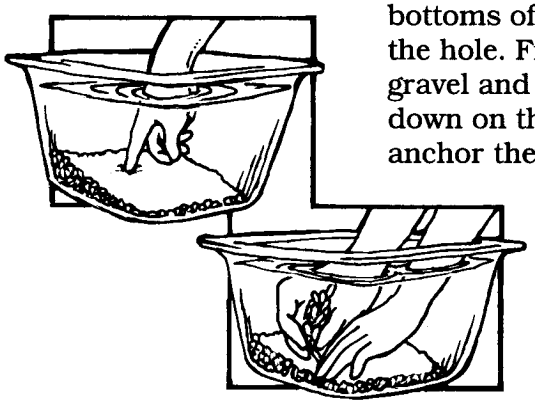


6. Slowly add water to the middle of the tank until you reach the waterline mark. The water will hit the paper and not disturb the gravel.

7. Remove the paper and throw it away.

8. Remove the leaves for about 2.5 cm (1 in) up from the bottoms of the two elodea sprigs.

   Poke a deep hole in the gravel with your finger. Place the trimmed bottoms of the sprigs in the hole. Fill the hole with gravel and press lightly down on the gravel to anchor the sprigs.



9. Float the two other elodea sprigs in the water.