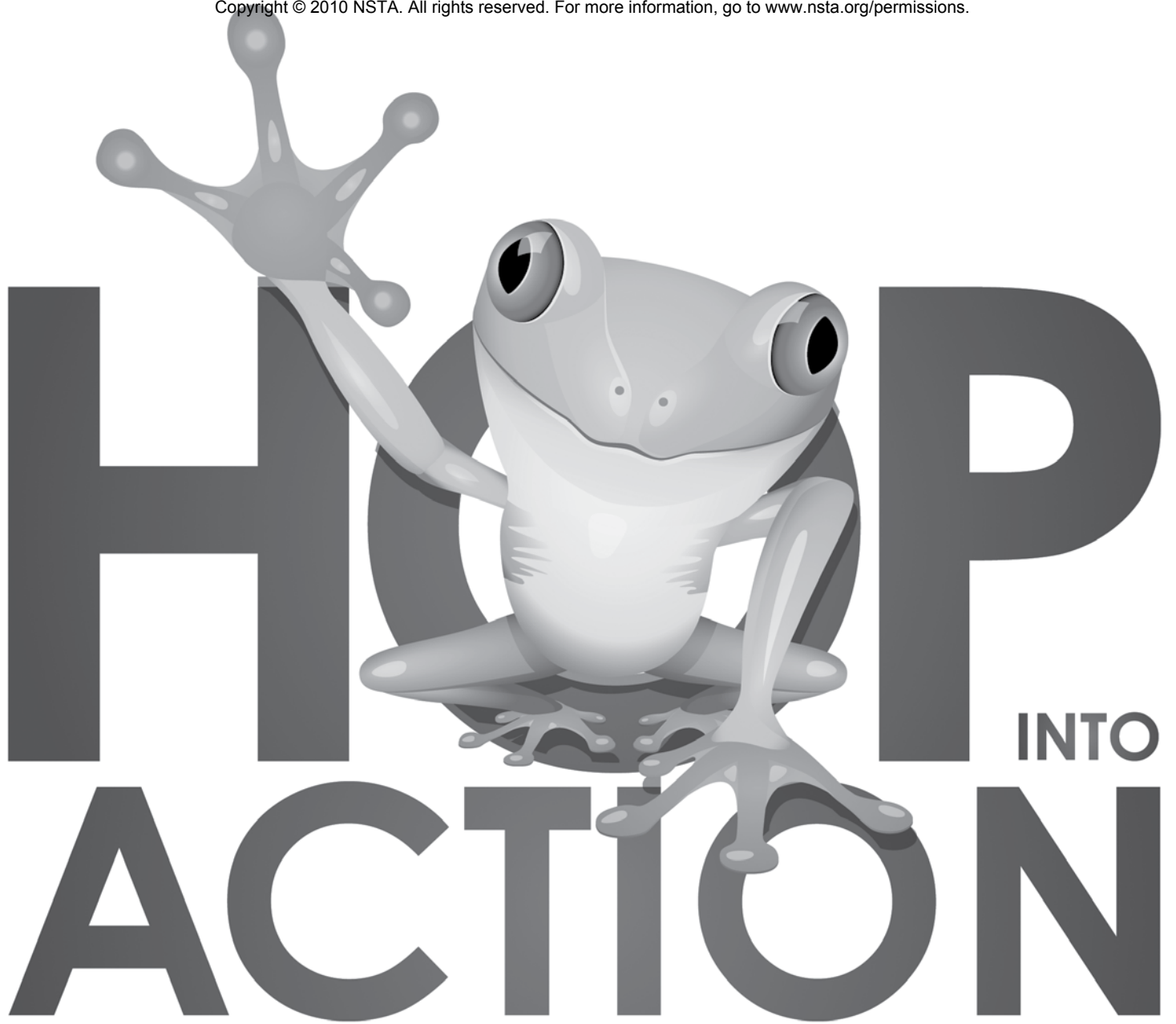


HOP INTO ACTION

The Amphibian Curriculum Guide for Grades K-4

David Alexander

NSTApress
National Science Teachers Association



The Amphibian Curriculum Guide for Grades K-4



HOP INTO ACTION

The Amphibian Curriculum Guide for Grades K–4

**David
Alexander**

NSTApress
National Science Teachers Association

Arlington, Virginia



Claire Reinburg, Director
Jennifer Horak, Managing Editor
Andrew Cooke, Senior Editor
Judy Cusick, Senior Editor
Wendy Rubin, Associate Editor
Amy America, Book Acquisitions Coordinator

ART AND DESIGN

Will Thomas Jr., Director
Joe Butera, Senior Graphic Designer, cover and interior design
Original art contributed by Natalia Hubisz
Cover illustrations by Laurent Renault and Rorat for iStock

PRINTING AND PRODUCTION

Catherine Lorrain, Director
Nguyet Tran, Assistant Production Manager

NATIONAL SCIENCE TEACHERS ASSOCIATION

Francis Q. Eberle, PhD, Executive Director
David Beacom, Publisher

Copyright © 2010 by the National Science Teachers Association.

All rights reserved. Printed in the United States of America.

13 12 11 10 4 3 2 1

Library of Congress Cataloging-in-Publication Data

Alexander, David, 1983-

Hop into action: the curriculum guide for grades K4/by David Alexander.

p. cm.

Includes index.

ISBN 978-1-936137-07-7

1. Amphibians—Study and teaching (Elementary) I. Title.

QL645.6.A45 2010

372.35'7—dc22

2010032137

eISBN 978-1-936137-57-2

NSTA is committed to publishing material that promotes the best in inquiry-based science education. However, conditions of actual use may vary, and the safety procedures and practices described in this book are intended to serve only as a guide. Additional precautionary measures may be required. NSTA and the authors do not warrant or represent that the procedures and practices in this book meet any safety code or standard of federal, state, or local regulations. NSTA and the authors disclaim any liability for personal injury or damage to property arising out of or relating to the use of this book, including any of the recommendations, instructions, or materials contained therein.

PERMISSIONS

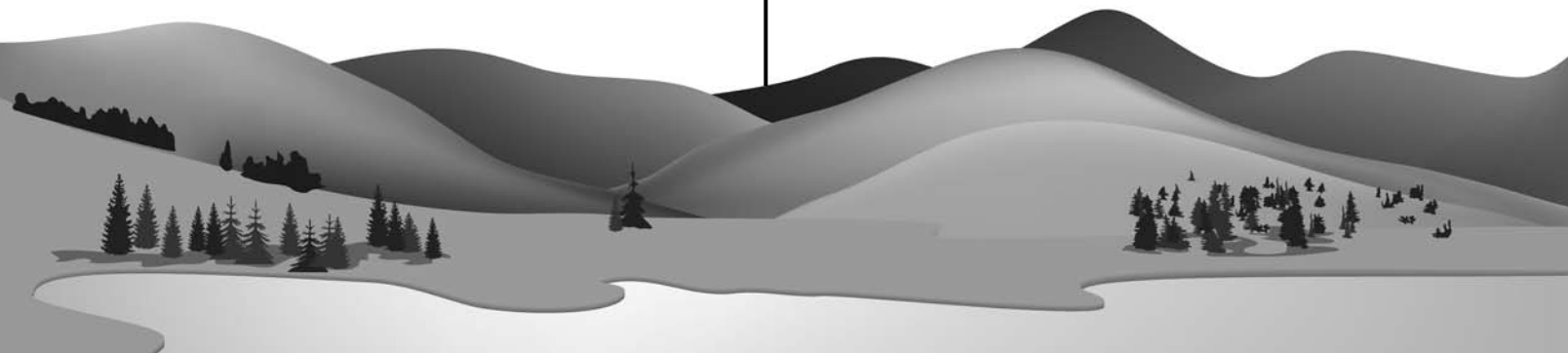
You may photocopy, print, or e-mail up to five copies of an NSTA book chapter for personal use only; this does not include display or promotional use. Elementary, middle, and high school teachers *only* may reproduce a single NSTA book chapter for classroom or noncommercial, professional-development use only. For permission to photocopy or use material electronically from this NSTA Press book, please contact the Copyright Clearance Center (CCC) (www.copyright.com; 978-750-8400). Please access www.nsta.org/permissions for further information about NSTA's rights and permissions policies.

CONTENTS

| | |
|--|-------|
| Preface..... | vii |
| Acknowledgments..... | ix |
| About the Author..... | xi |
| Introduction..... | xiii |
| How to Use This Book..... | xv |
| Amphibian Curriculum Guide: Lesson Correlations to National Science Education Content Standards, Grades K–4..... | xvii |
| Educating With Amphibians in the Classroom and Field..... | xix |
| Safety Practices for Outdoors and in the Classroom..... | xxiii |
| Lessons for Prekindergarten Learners..... | xxv |
| Resource List..... | 111 |
| Glossary..... | 117 |
| North American Association for Environmental Education Guidelines Alignment Chart..... | 121 |
| Index..... | 127 |

Amphibian Education Lessons

| | |
|--|------------|
| 1. How to Identify an Amphibian..... | 1 |
| 2. Amphibian Encounter..... | 7 |
| 3. Amphibian Metamorphosis..... | 11 |
| 4. Lily Pad Venn Diagrams..... | 19 |
| 5. Frog Hop Relay Race..... | 27 |
| 6. Camouflaged Critters..... | 31 |
| 7. Amazing Amphibian Migration..... | 37 |
| 8. Frog Pond Soup..... | 51 |
| 9. Frog Pond Web..... | 55 |
| 10. Frog Pond Lifeguard..... | 65 |
| 11. Audible Amphibian..... | 73 |
| 12. Feeding Frenzy..... | 77 |
| 13. Salamander Smell..... | 79 |
| 14. Frog Pond Poetry..... | 81 |
| 15. Ribbiting Discoveries in the Lily Pad Paper.... | 85 |
| 16. Seasonal Discoveries Journal..... | 89 |
| 17. Herp, Herp, Hooray..... | 93 |
| 18. Frog Pond Choices..... | 97 |
| 19. Frogville Town Meeting..... | 101 |
| 20. Amphibian Art..... | 107 |



Preface

Amphibian education and community involvement is critical at this time. We face a global amphibian extinction crisis. Of the more than 6,000 recognized species of amphibians, more than one third are suffering serious declines or have recently become extinct, despite having survived millions of years. If we do not educate our youth to appreciate, understand, and take action for amphibians and their environments, the amphibians are destined to go the way of the dinosaurs. The *Hop Into Action* curriculum guide was developed in response to this urgency in order to arm educators from a variety of settings with tools they can use to incorporate effective environmental education for learners in kindergarten through fourth grade.

As an educator, you are the audience for this guide, which offers 20 lessons that can be used individually or as a curriculum. In addition it

- includes interdisciplinary approaches to curriculum areas to meet national standards;
- is designed for classroom teachers, home school educators, naturalists, and camp leaders;
- provides lessons geared for grades K–4, with some appropriate content and extensions for younger and older grade levels; and
- was created from the firsthand experience of educators in both formal and informal learning environments.

Because amphibians form a link between aquatic and terrestrial environments, they offer exciting opportunities for education and also can be used to educate across multiple subject areas. Educating students about these species will be critical to foster awareness and social concern that may one day lead to stewardship and conservation. Lessons provide opportunities for students to build skills as environmental advocates and understand the vital need to protect our living world.

Through active, hands-on learning about the environment, children develop the knowledge and skills to address challenges in their communities while contributing to their own academic achievement.

Acknowledgments

Developed over five years of teaching outdoor environmental education, *Hop Into Action* is a collection of lessons for facilitating children's activities in the natural world. All creative works depend on experiences that preceded them, and this curriculum guide is no exception. In that light, I'd like to offer my thanks to those teachers, professors, naturalists, and other environmental education facilitators who have captured my attention and imagination and made my learning experiences both fun and meaningful. Finally, I owe my first debt of gratitude to my parents, who encouraged me to run free in the natural world, even if it meant coming home covered in both mud and duckweed and leaving a trail of smelly boots and other equipment to greet visitors at the door.

About the Author

David Alexander is an experienced naturalist who uses the environment to educate a diverse group of students at all age levels. He earned his graduate degree in environmental science, conservation biology at Green Mountain College and his bachelor's degree in natural resources at the University of Vermont. His enthusiasm and curiosity for the natural world is boundless.

Introduction

*H*op Into Action is an amphibian education curriculum designed for grades kindergarten through fourth grade in a way that allows students to apply knowledge from one lesson to others in the field and classroom. This cross-disciplinary curriculum guide introduces children to the joy of amphibians through investigations that involve scientific inquiry and knowledge building, while treating science as a process and not as memorization. In turn, these lessons bridge the gap between knowledge and action by promoting critical thinking, problem-solving skills, and collaboration to help students become advocates for the environment.

Lessons are offered sequentially, but they may be used out of sequence if students are learning at the grade level listed and educators are familiar with students' prior knowledge. Lessons are tailored to allow for extensions to multiple learning styles as needed for students who experience and process information differently. For example, kinesthetic learners will be provided the opportunity to have a concrete experience feeling a frog in the lesson about amphibian identification or using clay to demonstrate metamorphosis. Visual learners will benefit when participating in the creation of lily pad Venn diagrams or frog pond habitat webs that allow students to represent information spatially. Auditory learners will benefit from the discussion built into each lesson and specifically benefit from the lesson "Audible Amphibians," which offers the opportunity to hear the calls of frogs and toads. Finally, learners who enjoy and benefit most from reading and writing will love the stories provided as resources and thrive when participating in the lessons "Ribbiting Discoveries in the Lily Pad Paper" and "Seasonal Discoveries Journal."

Lessons also provide students with an understanding of career pathways as they act as biologists, herpetologists, ecologists, reporters, and park naturalists to investigate frog ponds.

The lessons included are designed to take advantage of and exercise children's natural curiosity about the environment using observation, photographs, games, and direct instruction. The curriculum includes reference materials such as field guides, websites, and storybooks that complement lessons and allow for study of species found in your own region. I hope you and your students learn to love, appreciate, and protect amphibians as a result of the fun and educational ideas provided in this guide.

How to Use This Book

Each lesson plan includes basic information for the instructor to determine if the activity will meet his or her needs. The following information is provided: grade/ability level, subject area, skills used, class setting, time required, and group size. Lessons describe in detail the objectives or observable student outcomes of each lesson; method of meeting the objectives for each lesson; materials required to perform the lesson; background information that will help educate the instructor about the lesson topic; a procedure to follow for presenting each lesson; evaluation questions and methods to assess the knowledge of students after the lesson; extensions that provide additional study related to the lesson; and resource information that includes books, audiovisual references, and web resources.

The activities in this guide were designed to meet content standards outlined in the *National Science Education Standards* and the North American Association for Environmental Education's *Excellence in Environmental Education: Guidelines for Learning (PreK–12)*.

Educators should modify their use of lessons to meet the learning goals of their students' ages and ability levels. Permission is granted in advance for reproduction for purpose of classroom or workshop instruction. To request permission for other uses, send specific requests to publisher.

The following table outlines the grade levels and subject areas covered for each lesson:

| Lesson Name | Grades | Subject Areas |
|------------------------------|--------|--|
| How to Identify an Amphibian | K–4 | Science, Language Arts, Art |
| Amphibian Encounter | K–3 | Science, Language Arts |
| Amphibian Metamorphosis | K–2 | Science, Drama, Art |
| Lily Pad Venn Diagrams | 3–4 | Science, Language Arts, Math |
| Frog Hop Relay Race | K–2 | Science, Physical Education |
| Camouflaged Critters | K–2 | Science, Art |
| Amazing Amphibian Migration | 2–4 | Science, Language Arts, Physical Education |
| Frog Pond Soup | 3–4 | Science, Language Arts |
| Frog Pond Web | 3–4 | Science, Language Arts |

HOW TO USE THIS BOOK

| Lesson Name | Grades | Subject Areas |
|---|--------|--------------------------------------|
| Frog Pond Lifeguard | 4 | Science, Language Arts |
| Audible Amphibian | 1–4 | Science |
| Feeding Frenzy | K–4 | Science, Physical Education, Math |
| Salamander Smell | 2–4 | Science |
| Frog Pond Poetry | 3–4 | Science, Language Arts |
| Ribbiting Discoveries in the Lily Pad Paper | 3–4 | Science, Language Arts, Media, Art |
| Seasonal Discoveries Journal | 3–4 | Science, Language Arts |
| Herp, Herp, Hooray | 4 | Science, Language Arts |
| Frog Pond Choices | 4 | Science, Language Arts |
| Frogville Town Meeting | 4 | Science, Language Arts, Civics |
| Amphibian Art | 2–4 | Science, Art, Language Arts, History |

Resource Information

National Research Council. 1996. *National science education standards*. Washington, DC: National Academies Press.

North American Association for Environmental Education (NAAEE). 2009. *Excellence in environmental education: Guidelines for Learning (preK-12)*. Washington, DC: NAAEE.

Amphibian Curriculum Guide

Lesson Correlations to National Science Education Content Standards, Grades K–4

Lesson

| Content Standard | Topic | Lesson | | | | | | | | | | | | | | | | | | | | |
|----------------------------|--|--------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
| A. Science as Inquiry | Abilities necessary to do scientific inquiry | | • | • | | | • | | | • | | | | | | | | | | | • | |
| | Understanding about scientific inquiry | | • | • | | | • | | | • | | | | | | | | | • | | | • |
| B. Physical Science | Properties of objects and materials | | | | | | | | • | | | | | | | | | | | | | |
| | Position and motion of objects | | | | | | | | | | | | | | | | | | | | | |
| C. Life Science | The characteristics of organisms | • | • | • | • | • | • | | | • | • | • | • | • | • | • | • | | | | • | • |
| | Life cycles of organisms | | | • | | | | | | • | | | | | | | | | | | • | |
| | Organisms and environments | | • | | | • | • | • | • | • | • | • | • | • | • | • | • | • | | | | • |
| D. Earth and Space Science | Properties of Earth materials | | | | | | | | • | | | | | | | | | | | | | |
| | Changes in the Earth and sky | | | | | | | | | | | | | | | | | | | | | • |

Amphibian Curriculum Guide

Lesson Correlations to National Science Education Content Standards, Grades K-4 (cont.)

Lesson

| Content Standard | Topic | Lesson | | | | | | | | | | | | | | | | | | | | |
|--|---|--------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
| E. Science and Technology | Abilities of technological design | | | | | | | • | | | • | | | | | | | • | • | | | |
| | Understanding about science and technology | | | | | | | | | • | | | | | | | | | • | • | | |
| | Abilities to distinguish between natural objects and objects made by humans | | | | | | | | • | | | | | | | | | | | | | |
| F. Science in Personal and Social Perspectives | Characteristics and changes in populations | | | | | | | • | | | | | | | | | | | • | • | | |
| | Changes in environments | | | | | | | | • | | | | | | | | | | | | | |
| | Science and technology in local challenges | | | | | | | | | | | | | | | | | | • | • | | |
| G. History and Nature of Science | Science as a human endeavor | • | • | | | | | | | | | | | | | | | | • | • | | • |

Educating With Amphibians in the Classroom and Field

Amphibians in the Classroom

Due to the care and commitment required, educators should always receive permission from administrators before moving forward with housing amphibians in a nature center, recreation center, or classroom. Teachers should check with their board of education, school administrators, and the school nurse before housing amphibians in a classroom or handling them in the outside environment. Educators should have a plan in writing that describes any necessary funding and a care schedule that takes into account weekends and school breaks.

In a classroom, it is important that amphibians act as “Animal Ambassadors” that help educate students about their respective species. If, as an educator, you choose to host an animal ambassador, you may want to consult your students before making all the decisions. Consider the following questions:

- How would you create a habitat for the amphibian that provides basic needs and closely resembles the natural habitat? What does the amphibian need to survive? How can we create a habitat in our classroom that includes all of these things? Consider moisture, light, temperature, and food.
- What do amphibians need to eat? Do they eat the same things at all life stages?
- Should we hold and handle the amphibian?
- How long should we keep the animal in this artificial or model habitat?

Giving children the chance to help with this planning process will allow them to think deeply about the ways habitats meet the needs of animals. Ultimately, an amphibian in the classroom should be treated as an ambassador of its species and cared for with the utmost respect through responsible handling, feeding, maintenance, and general care schedules. Only one species of amphibian should be maintained in a classroom at one time, and it should not come into contact with anything else shared with other animals unless sterilized for health and safety reasons.

There are many biological science suppliers that offer live amphibians for classroom use; however, they may only be available at certain life stages throughout the seasons and require planning ahead. *After the completion of the curriculum,*

Educating With Amphibians in the Classroom and Field

amphibians purchased for use in the classroom should not be released into nearby habitats, but rather kept and cared for until the end of their lives. You may find your local herpetological society helpful at finding someone who can provide the care needed or at last resort a veterinarian can euthanize according to the American Veterinary Medical Association's (AVMA) Guidelines on Euthanasia.

This is important because releasing captive amphibians can spread disease or organisms against which native wildlife may not have immunity. The released amphibians may also not be native to the habitat or not have time to adjust to the seasonal changes taking place and therefore not capable of survival.

If amphibians are collected outside for short-term classroom use (see permits on following page) they may be released at the capture site so long as proper sanitation procedures were followed (as outlined on the following page).

There are many opportunities to educate students about how to care for amphibians. Anne Mazer's book *The Salamander Room* is a great place to start a discussion regarding the responsibilities involved for younger learners. It is also important to distinguish the fantasy from reality found in books and movies so students begin thinking about the basic needs of living things and how they are met.

Amphibians in the Field

The best place to learn about the environment is the natural environment. The proximity of a pond to a classroom allows a much more intimate relationship with nature in terms of students being able to observe it with relatively little time and effort involved. It also helps to use local natural and cultural surroundings as the context for instruction and learning. When this place-based education is implemented, students and community members can benefit from partnerships.

Many students will benefit from opportunities to move in and out of open and focused explorations in a natural setting. When students are asked to focus their attention toward work, reading, or tests, they can feel fatigued. When they have opportunities for open exploration, involuntary attention can take over, giving the brain time to relax, in turn leading to better behavior and concentration. In addition, offering students playful learning opportunities can lead to better academic success and both interest in and excitement about the subject area.

Students should be briefed about what they might see outside, as some may be timid or scared if they have not had experience exploring the natural world. You should also discuss general discipline with students, including school rules that apply while outside.

Amphibian habitats may be found with assistance from a local environmental center, parks and recreation department, or state fish and wildlife agency. If your organization does not have access to a pond or other suitable habitat, you should consider creating a backyard or schoolyard habitat. Excellent resources exist from both the National Wildlife Federation and Tree Walkers International that will

Educating With Amphibians in the Classroom and Field

help you build a pond habitat suitable for amphibians. Remember that depending on the distance and weather conditions, field outings may require field essentials such as rain gear, rubber boots, waders, waterproof notebooks, and more (review *Safety Practices for Outdoors and in the Classroom*, p. xxiii). For younger students, you may even choose to consider life jackets as a safety precaution.

Handling Techniques

As with handling all life, we must show our students how to be respectful. It is important that all handlers wash their hands before and after holding or touching an amphibian. Improper handling of amphibians can be detrimental to their health, so an adult should always be present to assist. One technique that should be encouraged is to sit low while holding an animal so if it squirms or hops there won't be an injuring fall. Gently touching with one finger should also be encouraged.

Things to remember:

- Return amphibians to the same location where they were found. If found under a log or rock, place the amphibian next to the cover item and return the cover item as it was found. Consider the cover item to be similar to the roof of a house. It maintains a microclimate that the amphibian requires.
- Avoid getting insect repellent, sunscreen, or other personal care products on hands, as it may absorb into the skin of the amphibian.
- If you are exploring outside environments, be careful not to disturb the habitat you wish to study. You may remind younger students of this by explaining that “plants grow by the inch but die by the foot.”

Disinfectant Techniques

Before and after placing amphibians in tanks or in contact with equipment—including nets, filters, and boots—a disinfectant should be applied to the equipment. First clean with a detergent and rinse clean prior to bleaching. A 1% solution of household bleach (usually a 4% solution of sodium hypochlorite) can be made using one part household bleach to three parts water; a minimum contact time with equipment of 15 minutes is necessary.

It is also important to age chlorinated water for 24 hours, or use a drop of Chlor Out to dechlorinate water before introducing the animal, or the chlorine can harm it.

Permits

Care should be taken to acquire all necessary information and permits before purchasing or collecting wildlife, as some species may be threatened or endangered. There may be national laws as well as state laws that restrict and regulate what

Educating With Amphibians in the Classroom and Field

species are available for outside handling or inside education. Your state department of environmental protection or fish and game should be able to provide you with a list of protected species and permit applications.

Resource Information

American Veterinary Medical Association (AVMA). www.avma.org

Mazer, a. 1994. *The salamander room*. New York: Dragonfly Books.

Mendelson, J. 2009. Considerations and recommendations for raising live amphibians in classrooms. Society for the Study of Amphibians and Reptiles, www.ssarherps.org/documents/amphibians_in_classroom.pdf.

National Research Council. 1996. *National science education standards*. Washington, DC: National Academies Press.

National Science Teachers Association. Responsible use of live animals and dissection in the science classroom. NSTA. www.nsta.org/about/positions

North American Association for Environmental Education (NAAEE). 2009. *Excellence in environmental education: Guidelines for Learning (preK-12)*. Washington, DC: NAAEE.

Wyzga, M. 1998. *Homes for wildlife: A planning guide for habitat enhancement on school grounds*. Concord, NH: New Hampshire Fish and Game Department.

Safety Practices for Outdoors and in the Classroom

Outdoors

1. Teachers should always visit outdoor areas to review potential safety hazards prior to students carrying out activities.
2. Keep clear of outdoor areas that may have been treated with pesticides, fungicides, or other hazardous chemicals.
3. When working outdoors, students should use appropriate protective equipment, including safety glasses or safety goggles (if working with hazardous chemicals), gloves, closed-toed shoes, long-sleeve shirts and pants.
4. Caution students of poisonous plants (e.g., poison ivy, sumac), insects (e.g., bees, ticks, mosquitoes), and hazardous debris (e.g., broken glass).
5. Teachers need to inform parents in writing of on-site field trips relative to potential hazards and safety precautions taken.
6. Teachers need to check with the school nurse relative to student medical issues (e.g., allergies, asthma). Be prepared for medical emergencies.
7. Teachers need to have a means of communication (cell phone, two-way radio) in case of emergencies.
8. Wash hands with soap and water after doing activities outdoors.
9. Contact the main office prior to taking classes out of the building.

In the Classroom

1. Always review Material Safety Data Sheets (MSDS) with students to go over safety precautions in working with hazardous chemicals.
2. Remind students only to observe animals. Do not touch or pick up animals unless instructed to do so by the teacher.
3. Use caution in working with sharp objects such as scissors or glass slides.
4. Wear protective gloves when handling animals.
5. Do not eat or drink anything in the science lab or when handling animals.
6. Wash hands with soap and water after doing activities with hazardous chemicals, soil, or biologicals (plants or animals).
7. To disinfect cages and other equipment used in animal care, first wash the items in hot water with detergent. Scrape off stuck material. Rinse with plain water. Apply a bleach solution ($\frac{1}{2}$ cup household bleach to 1 gallon of water). Let cage and equipment sit in the bleach solution for a minimum of 20 minutes. Rinse again with plain water.
8. Use caution when working with clay. Dry or powdered clay contains a hazardous substance called silica. Only work with and clean up clay when wet.

Lessons for Prekindergarten Learners

While this guide was designed to provide comprehensive lessons to educators in kindergarten through fourth grade, provided here are lesson ideas for prekindergarten educators looking to add live event learning and hands-on science for little explorers.

Slime: Have children experience an amphibian-like substance with their sense of touch. Place the following ingredients in a plastic bag: 1 cup cornstarch, ½ cup water, green food coloring. Remove the air and knead the bag slowly until the mixture is well blended. Allow children to touch and play with the slime, but remind them not to taste it!

Getting Dirty: Have children play and experiment with mud (know the source of the dirt and make sure it is free of pesticides). Wash hands with soap and water after the lesson.

Sink or Float: Have children experiment with a water table to determine what sinks or floats. Predictions followed by results can be recorded on a chart.

Follow the Frog: Place amphibian pictures along a trail for children to find on their walk to the pond.

Hop Around: Follow the leader and imitate the movements of amphibians or other pond life.

Matching Frogs: Create a matching game where children must find like colors of frogs and pair them together. Or pair baby and mommy animal pictures.

Feeding Frenzy: Have children search around a field for “frog food” or strips of felt that represent the different foods frogs would find. Discuss what colors were easiest to find and why.

Tools of the Trade: Have children practice using hand lenses to discover details and see more in nature.

Seasonal Discovery: Have children revisit a pond or natural area monthly so they have opportunities to notice as much seasonal change as possible. Scavenger hunts can be added to the nature walk.

Frog Puppets: Have children paste premade pieces onto a paper bag to create their own frog puppets.

Popsicle Puppets: Have children color animals and paste them on sticks. They can be raised and lowered when the animals appear in a story or cast onto a sheet as shadows.

Lessons for Prekindergarten Learners

Prekindergarten Books

Faulkner, K. 1996. *Wide mouthed frog*. New York: Dial

Fleming, D. 2007. *In the small, small pond*. New York: Henry Holt.

Kent, J. 1982. *The caterpillar and the pollywog*. New York: Aladdin.

Lescroart, J. 2008. *Icky sticky frog*. Atlanta: Piggy Toes Press.

Lionni, L. 1996. *It's mine*. New York: Dragonfly Books.

Pallotta, J., and R. Masiello. 1990. *The frog alphabet book*. Watertown, MA:
Charlesbridge.



Lesson 5: Frog Hop Relay Race

Objectives

Students will be able to describe the characteristic movements of amphibians.

Method

Students describe and demonstrate the movement of amphibians and reptiles through a relay race.

Materials

Cones, hula hoops, soft flooring

Background Information

Amphibians have many different ways of moving around on land and in water. Depending on the type of amphibian, it might hop, leap, glide, climb, run, walk, or even burrow.

Some frogs have sticky suction-disked fingers that make them excellent acrobats and allow them to climb trees, while others have webbed feet that look like flippers and strong back legs, making them powerful swimmers and leapers. Some frogs can even stretch their webbed feet wide, parachuting or “plopping” into the air and gliding from one area to another (Stebbins and Cohen 1995).

Salamanders may not be able to jump as far or high as frogs, but they can scurry quickly and will leap with surprising grace to avoid capture, as the red-backed salamander does. The caecilians will push headfirst with worm-like

Grade Level: K–2

Subject Area: science, physical education

Skills: analysis, application, description, small-group work

Setting: inside or outside

Lesson Duration: 30 minutes

Group Size: 10 or more

National Science Education Standards, Grades K–4

- **Physical Science:** Position and motion of objects
- **Life Science:** The characteristics of organisms
- **Life Science:** Organisms and environments

5 Frog Hop Relay Race

contractions into the soil. The head is moved up and down with a ramming action to burrow in their direction of travel (Stebbins and Cohen 1995).

Amphibians will move for a variety of reasons, including capturing prey; avoiding becoming prey; finding a mate or egg-laying location; and finding suitable habitat that has food, water, shelter, and space.

Procedure

1. Begin a discussion with students about how amphibians move at different life stages and how their movements help them avoid predators. Discuss how each movement is an adaptation that allows the animal to survive.
2. Bring students to an open area and ask them to demonstrate the movements made at each life stage.
3. Split the students into two teams so that they can hop like a frog, slither like a salamander, and wiggle like a caecilian in a relay race. The instructor may choose the movement pattern or ask the teams to decide.
4. Instruct teams that only one student from each team will act out the prescribed movement at a time while it's their turn to race through the relay course. When the student returns to the line, the next player may take his or her turn. The first team to have all players participate wins.
5. Players will race through the course around cones or hop into and out of hula hoops and back to the group, where the next student will race, until all students have had a chance to participate.

Reflect and Explain

- Ask students if they could move like any amphibian which would they choose to move like and why?
- Call out different stages of amphibian growth for students to try while the relay race is in motion to test the students understanding of the variety of movement strategies.

Extensions

- Play a game in which students act as frogs that have to cross an open field past a tagger or “predator” without being caught or “consumed.” If caught, they instantly become a cattail and must stand swaying in the breeze.
- Create green headbands with a frog picture attached for students to wear in the relay race.
- Allow students to move like aquatic organisms or macroinvertebrates. For example, aquatic worms wiggle, amphipods swim on their sides, and dragonfly nymphs can shoot forward using “jet propulsion” as they push

a burst of water through their gills into their bodies and back into the water body.

- Add additional frog pond animal movements to your relay race. For example, fly like a duck, swim like a fish, and run backward like a crayfish escaping.
- Play a game of charades in which a student imitates a frog pond animal and the other students try to figure out its identity.
- Host a long-hop contest to see which team can hop the farthest.
- Create origami frogs that can actually jump.

Resource Information

Stebbins, R. C., and N. W. Cohen. 1995. *A natural history of amphibians*. Princeton, NJ: Princeton University Press.

Temko, F. 1986. *Paper pandas and jumping frogs*. San Francisco, CA: China Books and Periodicals.

North American Association for Environmental Education Guidelines Alignment Chart

Amphibian Curriculum Guide

Lesson Correlations to North American Association for Environmental Education Guidelines, Grades K–4

Lesson

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|--|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|---|
| Strand 1: Questioning, Analysis, and Interpretation Skills | | | | | | | | | | | | | | | | | | | | | |
| A. Generate and develop questions that are appropriate for initiating inquiry. | | | | | | | | • | • | • | • | • | | | | | • | • | • | | |
| B. Design simple investigations. | | | | | | | | | | • | | | | | | | • | | | | |
| C. Locate and collect information about the environment and environmental topics from a variety of resources. | | • | | • | | | | • | • | | | | | | | | • | • | • | | |
| D. Understand the need to use reliable information; explain some of the factors to consider in judging the merits of the information they are using. | | | | • | | | | | | • | • | | | | • | | | | | | • |
| E. Describe data and organize information to show relationships and patterns. | • | • | • | • | | | | • | • | • | • | • | | | • | • | | | | | |
| F. Work with models and simulations, using them to describe relationships, patterns, and processes. | • | | • | | • | | | | • | | | | | | | | | | | | |
| G. Describe their observations and develop simple explanations. | • | • | | • | • | • | | | • | • | • | • | | | • | • | | | | | |

Lesson

| Strand 2: Knowledge of Environmental Processes and Systems | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|--|--|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|--|
| 2.1—The Earth as a Physical System | | | | | | | | | | | | | | | | | | | | | | |
| A. Identify and explain changes and differences in the physical environment. | | | | | | | | | | | • | | | | | | | • | | | | |
| B. Identify and describe basic characteristics of and changes in matter. | | | | | | | | | | | | | | | | | | | | | | |
| C. Describe the basic sources and uses of some different forms of energy (light, heat, etc.). | | | | | | | | | | • | | | | | | | | | | | | |
| Strand 2: Knowledge of Environmental Processes and Systems | | | | | | | | | | | | | | | | | | | | | | |
| 2.2—The Living Environment | | | | | | | | | | | | | | | | | | | | | | |
| A. Identify similarities and differences among a wide variety of living organisms; describe organisms' basic needs, habitats, and ways organisms meet their needs in different habitats. | | | | | | | | | | • | | | | | | | | | | | | |
| B. Explain that both plants and animals have different characteristics and that many of the characteristics are inherited from their parents. | | • | | | | | | | | | | | | | | | | | | | | |
| C. Explain basic ways in which organisms are related to their environments and to other organisms. | | | | | | | | | | | | | | | | | | | | | | |
| D. Explain that living things need some source of "energy" to live and grow and that matter is recycled—e.g., through life, growth, death, and decay. | | | | | | | | | | | | | | | | | | | | | | |

Lesson

| Strand 2: Knowledge of Environmental Processes and Systems | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|--|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|
| 2.3—Humans and Their Societies | | | | | | | | | | | | | | | | | | | | |
| A. Identify ways that people act as individuals and as group members, and give examples of ways groups influence individual actions. | | | | | | | | | | | | | | | • | | | • | | • |
| B. Give examples of how experiences and places may be interpreted differently by people with different cultural backgrounds, at different times, or with other frames of reference. | | | | | | | | | | | | | | | • | | | • | | • |
| C. Describe government and economic systems that exist because people living together in groups need ways to do things (such as provide for needs and wants, maintain order, and manage conflict). | | | | | | | | | | | | | | | | | | • | | |
| D. Understand how people are connected at many levels—including the global level—by actions and common responsibilities that concern the environment. | | | | | | | | | | | | | | | | | | • | | • |
| E. Recognize that change is a normal part of individual and societal life and that conflict is rooted in different points of view. | | | | | | | | | | | | | | | | | | | • | • |

Lesson

| Strand 2: Knowledge of Environmental Processes and Systems | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|--|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|---|
| 2.4—Environment and Society | | | | | | | | | | | | | | | | | | | | | | |
| A. | Identify ways people depend on, change, and are affected by the environment. | | | | | | | • | | | • | | | | | | • | | | • | • | |
| B. | Describe ways places differ in their physical and human characteristics. | | | | | | | | | | | | | | | | | • | | | • | |
| C. | Demonstrate an understanding of “resources” and describe various sources and origins of resources they use in their lives. | | | | | | | | | • | | | | | | | • | | | | | |
| D. | Understand that technology is an integral part of human existence and culture. | | | | | | | • | | | | | | | | | | • | | | • | |
| E. | Identify and describe a range of local environmental issues and understand that people in other places also experience environmental issues. | | | | | | | | | | | | | | | | • | | | • | • | |
| Strand 3: Skills for Understanding and Addressing Environmental Issues | | | | | | | | | | | | | | | | | | | | | | |
| 3.1—Skills for Analyzing and Investigating Environmental Issues | | | | | | | | | | | | | | | | | | | | | | |
| A. | Identify and investigate local environmental issues. | | | | | | | | | | • | | | | | | • | | | • | • | |
| B. | Speculate about and explore the social, economic, and environmental consequences of issues and proposed solutions to them. | | | | | | | | | | • | | | | | | | • | | | • | |
| C. | Identify and evaluate alternative approaches to resolving issues. | | | | | | | | | | | | | | | | | | | | • | • |
| D. | Discuss and critique ideas representing different perspectives; hear and respect viewpoints that differ from their own. | | | | | | | | | | | | | | | | | | | | • | • |

Lesson

| Strand 3: Skills for Understanding and Addressing Environmental Issues | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|--|
| 3.2—Decision-Making and Citizenship Skills | | | | | | | | | | | | | | | | | | | | | |
| A. Examine and express their own views on environmental issues. | | | | | | | | | | | | | | | | | | | | | |
| B. Consider whether they believe action is needed in particular situations and whether they think they should be involved. | | | | | | | • | | | • | | | | | | | | | | | |
| C. Learn the basics of individual and collective action, by participating in close-to-home issues of their choosing. | | | | | | | | | | | | | | | | | | | | | |
| D. Evaluate the results of actions, understanding that civic actions have consequences. | | | | | | | | | | | | | | | | | | | | | |
| Strand 4: Personal and Civic Responsibility | | | | | | | | | | | | | | | | | | | | | |
| A. Identify the fundamental principles of U.S. society and explain their importance in the context of environmental issues. | | | | | | | | | | | | | | | | | | | | | |
| B. Understand the basic rights and responsibilities of citizenship. | | | | | | | | | | | | | | | | | | | | | |
| C. Possess a realistic self-confidence in their effectiveness as citizens. | | | | | | | | | | | | | | | | | | | | | |
| D. Understand that they have responsibility for the effects of their actions. | | | | | | | | | | | | | | | | | | | | | |

Index

A

Abiotic organisms, 51, 55, 117
Acid rain, 56
Action pledge, conservation, 96
Adaptation, 1
Algae, 51
Allergies, xxiii
Amphibian Specialist Group, website, 114
Amplexus, 11, 117
Analysis skill development, 19, 27, 51, 55, 65, 73, 77, 79, 81, 85, 89, 93, 97, 101, 107
Anura, 117
Application skill development, 27, 55, 65, 73, 77, 79, 85, 101, 107
Aquatic organisms, 12, 28, 56, 63, 65–71, 113, 117, 119
Aquatic worms, 56, 63, 70
Arboreal, 117
Army of frogs, 117
Arrowheads, 60
Art, 1–5, 7–11, 19–26, 31–35, 85–87, 107–109
Asthma, xxiii
Audio aids, 112

B

Backbone, 21–23
Basho, Matsuo, 81
Basking, 117–118
Bees, cautioning students regarding, xxiii
Beetles, 51, 56
Behavior of amphibians, 10
Behaviors, 8, 10, 37, 117
Bio-indicators, 117

Biodiversity, 115, 117
Biotic organisms, 51, 55, 117
Biotic parts, 51
Blackfly larvae, 70
Bleach, use as disinfectant, xxi
Body parts, regeneration of, 32
Body temperatures, regulation of, 89
Brain, 22–23
Brightly colored organisms, camouflage, 31
Broken glass, cautioning students regarding, xxiii
Bullfrogs, 64

C

Caddis fly nymphs, 70
Caecilian, 2, 4, 20, 28, 117
structure of, 4
Camouflaged organisms, 31–35
Captivity, 94, 117
Carnivores, 57, 117
Cattails, 51, 60
Cell phone use, xxiii
Chains, laying eggs in, 21
Chamber of commerce, perspective of, 103
Characteristics of organisms, 1, 7, 11, 19, 27, 31, 55, 65, 73, 77, 79, 81, 85, 89, 101, 107
Chemicals, hazardous, outdoor areas treated with, xxiii
Children’s books, 111–112
Chlor Out, use as disinfectant, xxi
Chytrid fungi, 117
Citizen scientists, 38, 66, 117
Civic involvement, 94, 101–105
Clams, 51
Claws, 23

Index

- Closed-toed shoes, xxiii
 Clusters, laying eggs in, 22
 Cold-blooded organisms, 2, 19, 23, 26, 89, 117, 119
 Coloration, 31–32
 Communication issues, xxiii
 Community stakeholders, 101–105
 Conservation, 9, 66, 86, 93–96, 102, 104,
 113–114, 117
 perspective of coalition, 104
 pledge of action, 96
 programs for, 93
 Construction workers union, perspective of, 104
 Consumer organisms, 57, 117
 Cordillera Central, Colombia, conservation
 program, 93–94
 Crane fly larvae, 70
 Crayfish, 51
 Cycles of life, 9, 11, 14–15, 51, 89–90, 111, 118–119
- D**
 Dart frogs, 119
 Debris, hazardous, cautioning students
 regarding, xxiii
 Decomposer organisms, 56–57, 117
 Deformity, 12, 117
 Democracy, 101, 117
 perspective of, 101
 Department of Transportation, 114
 Description of amphibians, 1
 Description skill development, 19, 27, 31, 37,
 51, 55, 73, 77, 79, 81, 85, 89, 93
 Deserts, adaptation for survival in, 1
 Designs, technological, 37, 65, 97, 101
 Disinfectant techniques, xxi
 Disturbing habitat, avoiding, xxi
 Diurnal patterns, 118
 Diversity, 38, 66, 74–75, 114, 118
 Dragonflies, 51, 60, 70
 Drama, 11, 19–26
 Drawing skills, 1, 31, 85, 89
 Dry skin, 21
- Ducks, 51, 60
 Duckweed, 60
- E**
 Eardrums, tympanic membrane, 74
 Earth materials, properties of, 51
 Ecology, 55–64, 113, 115, 118
 Ecosystems, 51, 55–57, 67, 69, 117–118
 living parts of, 51
 Ecotourism, 94
 Ectothermic organisms, 89, 117–118
 Eggs, 10–14, 16, 21–22, 38, 60, 67, 90, 118
 Elementary school environmental club,
 perspective of, 104
 Endangered species, 102, 107–109, 113, 118
 Endoskeleton, 118
 Energy, movement from sun to plants, 56
 Environmental consultants, perspective of, 104
 Environments, 7, 27, 31, 37, 51, 55, 65, 73, 77,
 79, 81, 85, 89, 97, 101, 107
 changes in, 37, 55, 101, 107
 Equipment, protective, use of, xxiii
 Evaluation skills, 97
 Extinction, 86, 118–119
 Eyes
 bulging, 22
 poison glands behind, 21
- F**
 Fat within body, 90
 Federal Highway Administration Critter
 Crossing, website, 114
 Feeding patterns, 77–78
 Field guides, 112
 Fields, adaptation for survival in, 1
 Fish, 51
 Food
 chain, 118
 web, 64, 66, 118
 Forests, adaptation for survival in, 1
 Found location, returning amphibians to, xxi

Frogs, 2–5, 9, 11–15, 20, 22, 27–29, 31–33, 39,
42, 44, 48, 51–62, 64–70, 73–75, 77–78,
81–83, 85–86, 89–90, 94, 97–100, 102,
104, 108, 111–112, 114, 117–119
structure of, 4
Frost, Robert, 81
Fungi, chytrid, 117
Fungicides, outdoor areas treated with, xxiii

G

Gills, 11–13, 21–26, 29, 118
Gland, parotid, 118
Goggles, use of, xxiii
Grade levels
4, 65, 93, 97, 101
1–4, 73
2–4, 37, 79, 107
3–4, 19, 51, 55, 81, 85, 89
K–2, 11, 27, 31
K–3, 7
K–4, 1, 7, 11, 19, 27, 31, 37, 51, 55, 65, 73, 77, 79,
81, 85, 89, 93, 97, 101, 107

H

Habitats, 2–3, 5, 7–9, 12, 28, 32–33, 38–39,
49, 51–53, 55–58, 66, 69, 74–75, 77, 79,
81–82, 86, 93–95, 97, 100, 102–104, 108,
113–114, 117–118
adaptation for survival in, 1
creating, 113
destruction of, 38, 57, 108, 118
disturbing, xxi
fragmentation of, 38, 118
livability of, 51
Hazardous chemicals, outdoor areas treated
with, xxiii
Heart, 22–23
Herbivore organisms, 57, 77, 118
Hérons, 60
Herpetologists, 8, 38, 118
Herpetology, 113, 118

Hibernation, 38, 90, 118–119
Hind legs, frogs, 22
History of science, 1, 107–109
Housing corporation, perspective of, 103
Human endeavor, science as, 31, 65, 73, 93, 97,
101, 107
Human-made objects, natural objects,
distinguishing, 51

I

Identification of amphibians, 1–5
Identification skills, 19, 31, 37, 55, 65, 73, 77, 79, 89
Indicator species, 12, 56, 66, 118
Inferences, 37, 55, 65, 77, 79, 85, 89, 101
Informing parents of field trips, xxiii
Insect repellent, avoiding hand contact, xxi
Insects, cautioning students regarding, xxiii
Interconnectedness, 9, 118
Invertebrates, 65, 67, 69–70, 118

J

Jelly-like eggs, 23
Journal writing, 89–92

L

Lakes, 12, 40, 86, 91, 102–104, 112, 118–119
Larva, 11, 118
Leathery eggs, 23
Life cycles of organisms, 9, 11, 14–15, 51, 55,
89–90, 101, 111, 118–119
Lily pad Venn diagrams, 19–26
Liverworts, 51
Living parts of ecosystem, 51
Long-sleeve shirts, xxiii
Lungs, 21–23, 118

M

Macroinvertebrates, 28, 66, 118
Material Safety Data Sheets, xxiii
Mathematics, 19, 27–29, 77–78
Mayfly nymphs, 70

Index

- Media, 85–87
- Medical issues, xxiii
- Metamorphosis, 11–17, 19, 21, 24, 38, 90, 118
- parts, 11
- Midge larvae, 70
- Migration, 37–49, 118
- cards, 42–49
- worksheet, 41
- Mosquito larvae, 70
- Mosquitoes, 51
- cautioning students regarding, xxiii
- Mosses, 51
- Motion of objects, 27
- N**
- National Phenology Network, website, 114
- National Science Education Standards, 1, 7, 11, 19, 27, 31, 37, 51, 55, 65, 73, 77, 79, 81, 85, 89, 93, 97, 101, 107
- National Wildlife Federation, Frog Watch USA, website, 114
- Native habitats, camouflage blending into, 32
- Natural objects, human-made objects, distinguishing, 51, 55
- Nature of science, 1, 7
- Newspaper, composition of, 85–87
- Nocturnal organisms, 78, 118
- North American Association for Environmental Education Guidelines Alignment Chart, 121–125
- North American Reporting Center for Amphibian Malformations, website, 114
- O**
- Obtaining permits, xxi–xxii
- Omnivore organisms, 57, 118
- P**
- Paper, composition of, 85–87
- Parasites, 66
- Parents, informing of field trips, xxiii
- Parotid gland, 118
- Partners in Amphibian and Reptile Conservation, website, 114
- Permeability, 2, 56, 66, 119
- Permits, obtaining, xxi–xxii
- Personal care products, avoiding hand contact, xxi
- Perspectives, varying, 101–105
- Pesticides, 56
- outdoor areas treated with, xxiii
- Phenology, 89, 91, 114, 119
- Physical education, 27–29, 37–49, 77–78
- Pickeralweeds, 60
- Planning board, perspective of, 103
- Pledge of action, conservation, 96
- Points of view, community stakeholders, 101–105
- Poison dart frog, 119
- Poison glands behind eyes, 21
- Poison ivy, cautioning students regarding, xxiii
- Poisonous plants, cautioning students regarding, xxiii
- Poisons, secretion by skin, 31
- Pollutants, 12, 56, 66, 119
- Pond ecology, 55–64
- Populations, changes in, 37, 55, 101, 107
- Position objects, 27
- Posture, 32, 119
- Prairies, adaptation for survival in, 1
- Predators, 12, 28, 31–32, 56–57, 77, 119
- aquatic, 12
- Prekindergarten learners, xxv–xxvi
- Preparation for medical emergencies, xxiii
- Prey, 12, 28, 31–32, 38, 46, 56–58, 77–79, 119
- Producer organisms, 57, 95, 112, 119
- Properties of objects, materials, 51
- Protective equipment, use of, xxiii
- Public speaking, 93, 97, 101

R

Ranita Dorado Amphibian Reserve,
conservation program, 94
Regeneration of body parts, 32
Regulation of body temperatures, 89
Reptiles, 23, 114, 119
Returning amphibians to location, xxi

S

Safety glasses, use of, xxiii
Salamanders, 2, 4–5, 12–15, 20, 22, 27–28, 32,
40, 60, 79–80, 86, 91, 111–112, 119
metamorphosis, 13
sense of smell, 79–80
structure of, 4
Scavenger beetles, 56
Scientific equipment suppliers, 113
Scuds, 70
Seasonal discoveries journal, 89–92
Self-efficacy, 94
Senior citizens group, perspective of, 103
Sense of smell, 79–80
Shoes, closed-toed, xxiii
Situation statements, 102
Skin
dry, 21
dry scaly, 23
moist, 23
permeability, 56, 66
poisons secreted by, 31
slimy, smooth, 22
Sky, changes in, 65, 85, 89
Small-group work, 1, 7, 27, 37, 51, 55, 77, 79,
97, 101
Smell, sense of, 22
Snails, 70
Snakes, 60
Social skills, development of, 94
Society for Study of Amphibians and Reptiles,
website, 114

Sodium hypochlorite, use as disinfectant, xxi
Sources of water, 7
Spawning, 119
Species, 12
Spermatophore, 12
“Spring Days,” 81
“Spring Pool,” 81
Stakeholders, 101–105, 119
Stored fat within body, 90
Stonefly larvae, 70
Structure of amphibians, 4
Student medical issues, xxiii
Sumac, cautioning students regarding, xxiii
Sunlight, 51–52
Sunscreen, avoiding hand contact, xxi
Swainson’s poison frog, 94
Swamps, 91, 112–113, 119
Synthesis skills, 65, 73, 93

T

Tadpoles, 11–13, 15–16, 86, 112, 118–119
Tail, regeneration of, 32
Technological designs, 37, 65, 97, 101
Technology, 65, 73, 93, 97, 101
Teeth, 21–22
Temperatures, regulation of, 89
Terrestrial organisms, 12, 56, 119
Terrestrial predators, 12
Tetrapods, 1, 119
Thousand Friends of Frogs, website, 113
Threatened species, 95, 107–108, 114, 119
Ticks, cautioning students regarding, xxiii
Toads, 14, 20–21, 73–75, 100, 112, 119
Torpor, 90, 119
Toxicity, 31, 119
Tree Walkers International, website, 114
Turtles, 51, 60
Two-way radio use, xxiii
Tympanic membrane, 74, 119

Index

U

- U.S. Department of Transportation: Federal Highway Administration Critter Crossing, website, 114
- USA National Phenology Network, website, 114

V

- Varying perspectives, 101–105
- Venn diagrams, 19–26
- Vernal Pool Association, website, 115
- Vernal pools, 12, 115, 119
- Vertebrae, 119
- Vertebrates, 11, 119
- Video aids, 112
- Vocal sacs, 21
- Vocalizations, 73–75, 119

W

- Water, 22–23
 - life in, 21
 - as place to lay eggs, 8
 - pollutants in, 66
 - quality indicators, 66
 - sources of, 7
- Web resources, 113–115
- Webbed feet, 27
- Wetlands, adaptation for survival in, 1
- Working together, 101–105
- Worms, 51, 56, 70
- Writing of journal, 89–92

