

**A Captive Care Guide, Teaching Curriculum and Animal Care References for Amphibians and Reptiles  
in a Secondary Education Classroom**

By

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University of Michigan-Flint

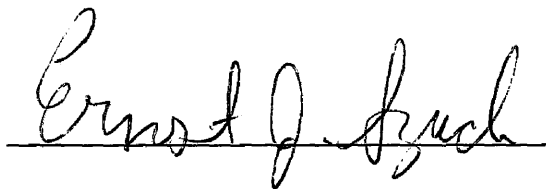
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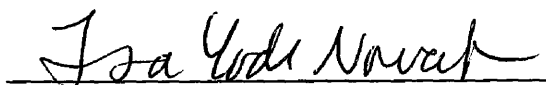
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## **Abstract**

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The objective of this project is to create teaching curriculum as well as ancillary resources regarding the use of native, captive bred and/or commonly used pet trade amphibian and reptile species in a secondary education classroom. The project will include a detailed list of reptile and amphibian veterinarians from around the state, a discussion regarding disposal of captives and rescues, information on housing, life expectancy, adult size, nutrition, good and bad choices of species to have in classrooms and /or nature center (both wild and captive list), and disclaimers (school policies, state and regional permits & policies, health and safety for your protection and the protection of the animal) all with emphasis on the instructor being the advocate for the animal as well as an emphasis for common or captive bred species being used instead of rare species.

## **Acknowledgements**

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I would like to thank Michigan Partners in Amphibians and Reptile Conservation for this opportunity to create such a unique thesis. Special thanks to Teresa Yoder-Nowak and Ernie Szuch of the University of Michigan-Flint, David Mifsud of Herpetological Resource and Management and MIPARC, James Harding of Michigan State University and Michelle Reckling of Rochester High School for their assistance in review and content knowledge.

## **Dedication**

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I would like to thank my family, friends and fiancé Ryan for their words of encouragement while I worked to accomplish this overwhelming task.

## **Chapter 1 – Introduction**

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### **Overview and Significance**

The significance of this project is to bring awareness of the importance of amphibians and reptiles as they function in communities and ecosystems. In order to do so, creation of content specific curricula, captive care guides and ancillary resources became necessary so that amphibians and reptiles could be integrated with ease into a classroom where they can educate many students. This project was created for the Michigan Partners in Amphibian and Reptile Conservation.

The Michigan Partners in Amphibian and Reptile Conservation (MIPARC) is a group of citizens, professionals and organizations that work to conserve the herpetofauna of Michigan as well as provide resources and education for those that care about the conservation of amphibian and reptiles. Amphibians and reptiles are poorly understood and often overlooked due to their appearance and habitat. This thesis will address the beneficial nature of amphibians and reptiles to the food chain and ecosystem as well as their role as biological indicators of the ecosystems health. This project was presented to me by MIPARC because I am an educator in a secondary education science position and I am well versed in the Content Expectations of the Science Curriculum as well as experienced in the ways of a high school classroom. The long term goal and contribution this project will provide will include not only the teaching curriculum, general animal care references and captive care guide for the many species chosen but also hopefully the eventual web-based access that will be available to the public as well as Zoo's and Nature centers.

## Statement of Purpose/Rationale

The significance for this thesis is to better educate the public on the life history of Amphibians and Reptiles. Amphibians and Reptiles play an important role in our ecosystem, are diverse in nature and species and are unique organisms that show important links in evolutionary history as well as a link in the overall ecosystem health. Often, these organisms are not well received due to the misconceptions and view of them being 'slimy', 'cold-blooded', 'mean', etc. Although they can fit some of these descriptions, their pro's far outweigh the public's pre-conceived ideas of 'con's'. Educating students and the public on these organisms will help to raise awareness of their beneficial nature and providing a representative organism to view in the classroom will help to provide a unique living model for students to view and interact with.

As reptiles and amphibians are not as cuddly or as readily identifiable to the human condition as mammals, it is important to recognize their significance in the ecosystem so that they do not become further victims in the never ending habitat loss and pet trade war. Reptiles are important in the ecosystem as both predator and prey in the food chain. They are often valuable to farmers to keep crops from being eaten by other organisms and are beneficial in the food chain as prey where larger reptiles, mammals, birds, etc., will consume them or their eggs. An amphibians role in the ecosystem works in very much the same way as they are predators of invertebrates, fish, smaller mammals and birds and can also serve as prey to other organisms such as mammals, birds, reptiles, other amphibians, etc. Amphibians act as an intermediate link in the food chain for many organisms that are not able to feed on/gain nutrients from invertebrate food sources. Amphibians have the ability to live in aquatic environments as well as cooler temperatures. This characteristic allows them to gain nutrients that may be inaccessible to many higher endothermic vertebrates. Amphibians also produce new tissue regularly; and therefore, are discussed as having high biomass conservation as they reproduce quickly and lose less heat to their environment. Amphibians are also important in the following areas: the Food Industry (i.e. Frog Legs), Teaching and Research for the studies of embryology, endocrinology, physiology, and ecology (i.e. divergence and speciation); Toxicology( i.e. egg and larvae vulnerability to toxins); as well as in the study of Medicine for the study of fever research and skin secretions (i.e. antimicrobial, defense, painkilling, neurological).

## Chapter 2- General Reference

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### Animals for Classroom Use

When considering using organisms for classroom use, it is best to use organisms that will not impact the fragility of the ecosystem such as rare organisms taken from the wild which would also require a permit. Organisms raised or bred in captivity or common native species are good pets to have in a classroom as their purchase/collection and use in a classroom will have little or no impact on animals found in the wild. It is always important to purchase an animal from a reputable source. Below are a few ideas of how to discern if a pet store is reputable.

A reputable pet store:

- Will have staff that can answer your questions without providing vague responses. Beware of pet stores that do not fully answer your questions or do not find another staff member who can.
- Will have healthy animals with alert, clear eyes, healthy looking bodies and faces clear of mucous running from the eyes and nose.
- Will have cages free of watery feces or excessive feces found throughout the cage
- Will have large cages (10 gallons and above) and only 1 species per cage without overcrowding
- Will have a mild odor. Beware of stores that smell strongly of feces or urine. Also beware of store that smell strongly of harsh chemicals or cleansers as can cause respiratory problems in amphibians and reptiles

Adapted from a contributor on eHow.com

[http://www.ehow.com/how\\_2057547\\_find-reputable-pet-store.html](http://www.ehow.com/how_2057547_find-reputable-pet-store.html)

Mid-Michigan Reptile Rescue is a great contact to find organisms to have in a classroom.

<http://www.petfinder.com/shelters/MI383.html>

Note the Mid-Michigan Reptile Rescue link at the bottom of the page. This link will re-direct you to pet-finder.com where you can view a listing of Reptiles and Amphibians ready for adoption.



Below is a summarized table of species from Michigan of Recommended, Not Recommended and Protected Animals

	Recommended	Not Recommended	Protected and Illegal to collect
<b>Aquatic Turtles</b>	<ul style="list-style-type: none"> <li>• Painted turtles</li> <li>• Red-eared slider turtles</li> <li>• Musk turtles</li> </ul>	<ul style="list-style-type: none"> <li>• Spiny softshell turtles</li> <li>• Map turtles</li> <li>• Snapping turtles</li> </ul>	<ul style="list-style-type: none"> <li>• Spotted turtles</li> <li>• Wood turtles</li> <li>• Blanding's turtles</li> </ul>
<b>Box Turtles</b>			<ul style="list-style-type: none"> <li>• Eastern box turtles</li> </ul>
<b>Frogs, Toads, Salamanders</b>	<ul style="list-style-type: none"> <li>• larger toads and frogs (green, leopard, and bullfrogs)</li> <li>• large salamanders (Tiger, Spotted)</li> </ul>	<ul style="list-style-type: none"> <li>• smaller frogs<sup>1</sup></li> <li>• Spring peepers<sup>1</sup></li> <li>• Chorus frogs<sup>1</sup></li> <li>• small salamanders<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Blanchard's cricket frogs</li> <li>• Marbled salamanders</li> </ul>
<b>Snakes</b>	<ul style="list-style-type: none"> <li>• Garter snakes<sup>3</sup></li> <li>• Brown and Red-bellied snakes<sup>4</sup></li> <li>• captive-bred Rat snakes, Corn snakes, and King snakes<sup>5</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Water snakes, Milk snakes, and Racers<sup>6</sup></li> <li>• Hognose and Green snakes<sup>7</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Black rat snakes</li> <li>• Eastern fox snakes</li> <li>• Kirtland's snakes</li> <li>• Copper-bellied water snakes</li> <li>• Eastern Massasauga rattlesnakes</li> </ul>

Modified from James Harding's website [www.critterguy.museum.msu.edu](http://www.critterguy.museum.msu.edu)

- These organisms are hard to feed
- These are delicate and hide often
- These are good for beginning snake keepers
- These are hardy but often hide
- These are good for educational purposes
- These are nervous and prone to bite
- These require special foods and are hard to feed

## **Veterinarian list**

An experienced veterinarian is extremely important when housing an Amphibian or Reptile in a classroom. The following list exhibits amphibians and reptile veterinarians in Michigan.

**Birmingham Vet Clinic**  
**33788 Woodward**  
**Birmingham, Michigan 48073**  
**Phone: 248-647-5474**

**Website: [www.birminghamveterinaryclinic.com](http://www.birminghamveterinaryclinic.com)**

**Care of: Lizards, Snakes, Turtles, Tortoises, Frogs, Toads**

**Howard J. Schwartz, D.V.M. \***  
**Clarkston Veterinary Clinic**  
**6687 Dixie Highway**  
**Clarkston, Michigan 48346**  
**Phone: 248-625-1821**

**Website: [www.clarkstonvet.net](http://www.clarkstonvet.net)**  
**HJSHERPVET@sbcglobal.net**

**Care of: Lizards, Snakes, Turtles, Tortoises, Newts-Salamanders**

\*This veterinarian belongs to the Association of Reptile and Amphibian Veterinarians

**Jennifer Periat DVM \***  
**Parkway Small Animal and Exotic Clinic**  
**39321 Garfield**  
**Clinton Township, Michigan 48035**  
**Phone: (586) 416-8800**  
**Emerg: (586) 416-8800**

**Website: [www.parkway-animal-hospital.com](http://www.parkway-animal-hospital.com)**

**Care of: Lizards, Snakes, Turtles, Tortoises, Frogs, Toads, Newts-Salamanders**

\*This veterinarian belongs to the Association of Reptile and Amphibian Veterinarians, Chicago Herpetological Association, Michigan Society of Herpetologists and the International Reptile Conservation Foundation. The clinic also subscribes to the Journal of Herpetological Medicine and Surgery.

**Dr. Ian Wright DVM**  
**Dunckel Veterinary Hospital**  
**2048 S State Rd**  
**Davison, Michigan 48423**  
**Phone: 810-653-3988**

**Website:** [www.dunckelvet.com](http://www.dunckelvet.com)

**Care of:** Lizards, Snakes, Turtles, Tortoises, Frogs, Toads, Newts-Salamanders

**Tim Whalen**  
**Cottonwood Veterinary Center**  
**7666 Cottonwood**  
**Jenison, Michigan 49428**  
**Phone: (616) 667-6700**

**Website:** [www.cottonwoodvetcenter.com](http://www.cottonwoodvetcenter.com)

**Care of:** Lizards, Snakes, Turtles, Tortoises, Frogs, Toads, Newts-Salamanders

**Dr. Pamela Graves**  
**Jensen's Animal Hospital**  
**4041 Charlevoix Avenue**  
**Petoskey, Michigan 49770**  
**Phone: 231-347-8775**  
**Emerg: 231-347-8775**

**Website:** [www.jensensanimalhospital.evetsites.net](http://www.jensensanimalhospital.evetsites.net)  
[animaldocs@jensensanimalhospital.com](mailto:animaldocs@jensensanimalhospital.com)

**Care of:** Lizards, Snakes, Turtles, Tortoises, Frogs, Toads, Newts-Salamanders

**Vickie Daldin-Marsh DVM**  
**Animal Kingdom Veterinary Hospital AKA Bird and Small Animal Hospital**  
**4990 Ann Arbor-Saline Road**  
**Saline, Michigan 48103**  
**Phone: (734) 913-0003**  
**Emerg: 734-913-0003**

**Website:** [www.animalkingdomveterinaryhospital.com](http://www.animalkingdomveterinaryhospital.com)

**Care of:** Lizards, Snakes, Turtles, Tortoises, Frogs, Toads, Newts-Salamanders

**Dr. Fear**  
**Parkview Animal Hospital**  
**1912 11 Mile Road**  
**Warren, Michigan 48092**  
**Phone: 586-573-4760**

**Website: [www.parkviewanimalhospital.com](http://www.parkviewanimalhospital.com)**

**Care of: Lizards, Snakes, Turtles, Tortoises, Frogs, Toads, Newts-Salamanders**

## How to dispose of captives or rescues and return to wild policy

Below is MIPARC's stance on captives being returned to the wild:

Releasing classroom pets or surplus laboratory specimens into the wild may be prohibited in your state, and in all cases it is unethical. Once released into the wild, many of these unwanted animals negatively impact native species and their ecosystems. Releasing classroom pets or laboratory animals into the wild can result in:

- the introduction of harmful pathogens and parasites;
- increased competition with native/resident species for resources;
- predation on native/resident species; and
- degradation of the native/resident population's gene pool.

Instead of releasing unwanted classroom or laboratory animals into the wild, consider one of the following alternatives:

- give the animal to another responsible teacher or school;
- return it to the place where it was bought;
- keep it as a classroom pet until the next semester; or
- donate it to your local natural history museum, science center, zoo, or aquarium; and
- humane euthanasia.

All of these alternatives outweigh the risk of releasing captive animals into the wild. To avoid the problem of what to do with unwanted classroom or laboratory animals, think about what you will do with them BEFORE you obtain them. Although the release of "one little animal" into the wild may seem benign, that action could have serious biological and legal consequences.

Developed by Parc.org

<http://www.parcplace.org/publications/brochures-and-handouts.html>

## **Metroparks in Michigan**

In order to view tank set-up, view animals or speak to educated professionals regarding Amphibians or Reptiles, you may want to visit a nature preserve or park OR speak to your local DNR representative. Below is a list of parks in Michigan that house live animals for both you and/ or your students viewing pleasure. It may be best to call the Metroparks in order to ascertain what animals are being displayed at a certain time.

### **Hudson Mills Metropark**

(734) 426-8211

8801 N. Territorial Road

P.O. Box 337

Dexter, MI 48130

### **Indian Springs Metropark Interpretive Center**

(248) 625-7280

5200 Indian Trail

White Lake, MI 48386

\*Contains an underwater pond room to view plants and animals from below!

### **Kensington Metropark and Nature Center**

(248) 684-8632

2240 W. Buno Road

Milford, MI 48380

### **Lake Erie Metropark Marshlands Museum and Nature Center**

(734) 379-5020

32481 W. Jefferson

P.O. Box 120

Brownstown, MI 48173

\*Contains a 1,300 gallon Great Lakes aquarium!

### **Metrobeach Metropark and Nature Center**

(586)-463-4332

31300 Metro Parkway

Harrison Township, MI 4804

### **Oakwoods Metropark and Nature Center**

(734)-782-3956

17845 Savage Road

Belleville, MI 48111

### **Stony Creek Metropark**

4300 Main Park Road

Shelby Township, MI 48316

(586)781-4242

\*Has live reptiles such as a Massasauga Rattlesnake and amphibians such as frogs and salamanders

Also, a link to the Department of Environmental Quality will help to provide nature centers close to you!

[http://www.michigan.gov/deq/0,1607,7-135-3307\\_3580-107287--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3307_3580-107287--,00.html)

## **Policies**

### **Hand washing for your protection and protection of the animal**

Always wash your hands before and after handling an amphibian or reptile. Soap, chlorine, sunscreen and insect repellents can harm the moist permeable skin of an Amphibian. The glandular secretions of most Amphibian species will irritate the mucous membranes (mouth, eyes, and nose) of humans. Reptiles also can carry salmonella, a type of bacteria as the normal flora of their bodies. Reptiles may not be a good pet to have in a classroom where smaller children are present.

## **Permits**

If you are collecting animals from the wild you should obtain a permit from the DNR.

Taken from [www.michigan.gov/dnr](http://www.michigan.gov/dnr) regarding Amphibians and Reptiles

**Personal Use:** An all-species fishing license is required to take amphibians and reptiles for personal use. Reptiles and amphibians may not be bought, sold, or offered for sale. Hand, trap, nets, seines (up to 12 x 4 feet overall dimensions), and hook and line may be used. Set lines may not be used to take turtles. Frogs may be speared but NOT with the aid of an artificial light. Traps used (or possessed) in areas frequented by reptiles must have a plate or tag attached bearing the name and address of the user in legible English. For taking turtles, no more than three (3) traps may be used, mesh traps must be no less than one (1) inch mesh, and traps must be set to allow turtles to surface and breathe. It is illegal to possess or transport in the field, dressed or processed reptiles or amphibians that cannot be measured or identified.

### **The following are organisms that require a permit for collection and captivity:**

Blandings, spotted, wood, and eastern box turtle; black rat snake, eastern fox snake, copperbelly watersnake, kirtlands snake and massasauga rattlesnake; boreal chorus frog, blanchards cricket frog; smallmouth salamander, marbled salamander; all reptile eggs; and amphibians and reptiles protected under Part 365 (Endangered Species) of 1994 P.A. 451. For further information, see list FO-224 from the DNR below.

## **FO - 224.08**

### **REGULATIONS ON THE TAKE OF REPTILES AND AMPHIBIANS**

Under the authority of sections 43509, 48702 and 48705 of 1994 PA 451, as amended, being sections 324.43509, 324.48702, and 324.48705 of the Michigan Compiled Laws, the Director of the Department of Natural Resources on December 6, 2007, ordered that:

It shall be unlawful to kill, take, trap, possess, buy, sell, offer to buy or sell, barter, or attempt to take, trap, possess or barter any reptile or amphibian from the wild, or the eggs of any reptile or amphibian from the wild, except as provided within this order.

## GENERAL

1. The following species of reptiles and amphibians shall not be taken from the wild and possessed except as authorized under a permit from the director:

Six Lined Racerunner (*Cnemidophorus sexlineatus*)  
Eastern Massasauga Rattlesnake (*Sistrurus catenatus catenatus*)  
Blanding's Turtle (*Emydoidea blandingii*)  
Wood Turtle (*Glyptemys insculpta*)  
Eastern Box Turtle (*Terrapene carolina carolina*)  
Black Rat Snake (*Elaphe obsoleta obsoleta*)  
Blanchard's Cricket Frog (*Acris crepitans blanchardi*)  
Boreal Chorus Frog (*Pseudacris triseriata maculata*)

Those reptiles and amphibians protected under the Endangered Species Act,

Part 365 of Act 451 of the Public Acts of 1994.

- A person may collect reptiles and amphibians or their eggs for research studies or other special use under a permit issued by the director's designated fisheries representative. The permit shall be valid only for the species, number, manner and time specified on the permit.
- A person may take certain species of reptiles and amphibians for personal use. See items listed under personal use.
- The taking of reptiles and amphibians for commercial purposes is prohibited.
- Reptiles may be taken only by hand, trap, seines up to 12 x 4 feet overall dimension, hand net, or hook and line as defined in Section 48703 of Act 451 of 1994.
- Amphibians may be taken by hand, hook and line, hand net or trap where not otherwise prohibited by law. In addition, frogs may be speared. As provided by Act No. 451 of the Public Acts of 1994, as amended, frogs shall not be speared with the aid of an artificial light.
- Traps used or possessed in areas frequented by reptiles must have a plate or tag attached bearing the name and address of the user in legible English.
- It is illegal to possess or transport in the field, dressed or processed reptiles or amphibians that cannot be measured or identified.
- A person shall immediately release to the wild any reptile or amphibian that is taken during a closed season, is under the legal size, or is otherwise protected.
- Snapping and softshell turtles may only be taken each year from July 15 to September 15.
- A person may only take and possess snapping turtles with a carapace length of 13 inches or more.
- Reptile eggs may not be disturbed or removed from the wild except as authorized under a permit by the Director.



## PERSONAL USE

1. Traps used for the taking of turtles shall be limited to no more than 3 traps, shall be constructed and set in a manner to allow turtles to surface and breathe, and shall be constructed of mesh at least 1 inch wide at the narrowest measurement.
2. All reptiles and amphibians taken for personal use shall not be bought, sold or offered for sale.
3. The following table lists the regulations that apply to the taking of reptiles and amphibians for personal use

Species	Season	Minimum Size (Inches)	Daily Possession Limit	Total Possession Limit
Frogs, toads, salamanders, mudpuppies	Last Sat. in May - Nov. 15	none	10 in any combination	10 in any combination
Snapping turtles Softshell turtles	July 15 - Sept. 15	13" minimum carapace length	2 in combination (no more than 1 of either species)	4 total in combination (no more than 2 of either species)
All other turtles (painted, musk, map, red-eared slider); snakes and lizards	Open for the entire year	none	3 in combination (However, no more than 2 turtles and no more than 1 of any one turtle species)	6 total in combination (However, no more than 4 turtles and no more than 2 of any one turtle species)

This order shall be assigned number FO-224.08, and is entitled "Regulation on the Take of Reptiles and Amphibians."

This order supersedes the order entitled "Regulation on the Take of Reptiles and Amphibians" effective October 12, 2001, and assigned number FO-224.02.

This order shall take effect April 1, 2008, and shall remain effective through March 31, 2013.

## Injuries

If an amphibian or reptile injured or found in the wild injured, the Department of Natural Resources website host a list of licensed rehabilitators available to help.

<http://www.michigandnr.com/dlr>

## Below is the MSPCA's stance on pets in a classroom



### Classroom Pets Introduction

A classroom pet can enhance a humane education curriculum and help students develop compassion and respect for animals. Teachers tend to acquire classroom pets with the intention of making the classroom more fun and interesting for students, but pets shouldn't be acquired simply for their entertainment value.

Acquiring a classroom pet in the hopes that it will teach responsibility to students may be too ambitious—it is best to teach responsibility first and ensure that students are mature enough to understand the many aspects of pet

guardianship before committing to the care of a classroom pet. Below is a sample Policy for Schools that can be adopted by districts looking to place guidelines on how classroom pets are cared for and which species may be kept as pets.

### Policy for Schools

Considerations to make in advance:

Before acquiring a classroom pet, the educator will investigate whether any student is:

- allergic or sensitive to any particular species or their food or bedding materials
- immune compromised, and therefore more susceptible to zoological illnesses

Educators will provide parents and guardians with information about the classroom pet, the purpose of acquiring the animal (how its care will fit into the curriculum), and a plan for how any injuries (bites, scratches) will be managed should they arise.

### Type of pet:

- only domestic animals may be kept as pets
- wild animals may not be kept as pets (this includes locally caught frogs, snakes, etc.)
- animal must be diurnal (awake during the day)
- pet should be acquired through an adoption center, rescue, or other re-homing opportunity whenever possible, rather than purchased from a pet store

### Responsibilities:

The primary educator in the classroom is considered the animal's guardian/caregiver, and is responsible for ensuring that all of the animal's physical and psychological needs are met.

### The animal's guardian is responsible for:

- researching the animal's species and consulting reliable sources (veterinarian, humane educator) regarding appropriate diet, housing, exercise, and socialization
- ensuring that the animal is fed appropriately, handled properly, and that its habitat is cleaned regularly; using logs to track feedings and cleanings is recommended
- seeking regular and emergency veterinary care for the animal (including vaccinations required by state law), and is responsible for all veterinary fees
- taking the animal home during weekends, holidays, and vacations
- continuing to care for the animal at home in the event that a future student is allergic and the animal is unable to live in the classroom

### Other criteria:

- classroom pets are not permitted to breed; if several animals of the same species are being maintained as classroom pets, males and females should be kept separate at all times
- students will only handle the animal under direct supervision of an adult
- if students are given responsibilities for feeding the animal or cleaning the animal's habitat, this will be assigned as a reward not as a punishment, and students will be supervised during all interactions
- students must wash their hands prior to and after handling the classroom pet or cleaning its habitat
- animals will be housed in a quiet area of the classroom away from windows, direct sunlight, heating vents, and drafts
- the heat in the classroom will be kept within an acceptable range during the nighttime

### Appropriate species:

Guinea Pigs—can be well socialized when handled appropriately and regularly; need room for exercise and ample housing

Ferrets—are generally very social animals; need very large cage space and plenty of supervised time out of the cage for exercise, so more appropriate for upper elementary levels; ferrets are required by law to be rabies vaccinated

Gerbils—sociable and curious; may be difficult for children to handle because of their small size, but they are fun to observe

Domestic Rats—sociable if handled regularly; very intelligent

Domestic Mice—sociable; may be difficult for children to handle because of their small size, but they are fun to observe

Fish—a good choice if a robust species; not generally interactive, but fun to observe

Inappropriate species:

Red-Eared Slider Turtles—reptiles require very consistent tank heating; their lifespan is over 30 years

Anoles (American chameleons)— require consistent tank heating; require very delicate handling

Hamsters—nocturnal (sleep through the day and awake at night), more likely to bite

Rabbits—most are relatively large and need a good amount of cage space and room to exercise; are naturally skittish and difficult to pick up; require a calm environment

Chinchillas—most need a good amount of cage space and room to exercise; they are naturally very curious and prefer exploration to being held and sitting calmly in one's lap; they are more prone to illness due to fluctuations in temperature and humidity, which can be difficult to control in a classroom.

DNR stance on wildlife as pets

**WILDLIFE SPECIES AS PETS**

The Department of Natural Resources does not recommend or encourage the possession of wildlife species as pets.

Some of the reasons for this are:

- There is no rabies vaccine approved for use for wildlife. Immunizations that protect dogs and cats do not necessarily protect wild animals. Vaccines that immunize domestic animals may even prolong or mask existing rabies infections in wild animals. The progress of rabies and its clinical signs in domestic animals is fairly predictable. Rabies in wild animals is considerably less predictable. An infected animal can undergo a variable incubation period where the virus remains dormant in the wound for over a year. Furthermore, when the animal does become infected, it may not show any symptoms of the disease, while still spreading great amounts of virus. There is no ten-day waiting period, as with a dog. By the time the animal becomes ill, a person who has been bitten could be beyond help. Therefore, if a pet wildlife species bites someone, the animal must be euthanized so that the brain can be tested for rabies.
- Wildlife pets can pose a serious threat to human safety. Wild animals, even when raised for generations in captivity, are still wild animals. As they grow older, they can unpredictably revert back to their wild instincts, sometimes biting and attacking for no apparent reason.
- The commercial pet trade can encourage the illegal taking of animals from the wild.
- Some people acquire wildlife species as pets for the wrong reasons. Some may think that having an unusual animal as a pet is chic, or that possessing these animals will improve some image they have of themselves, rather than truly caring for the welfare of the animal. Others acquire young wildlife species because they are cute and cuddly, but are not prepared for the responsibility of caring for the wild animal as it grows older and larger and sometimes becomes dangerous and deadly. Certain species of wild animals should be appreciated in their natural habitat without being owned as pets, and people in the market for a pet should strongly consider a homeless, domestic, dog or cat.

**FEDERAL REGULATIONS**

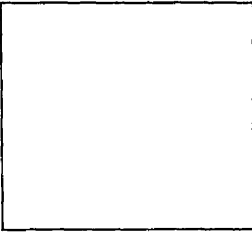
In addition to State rules and regulations identified herein, Federal regulations developed as part of the Animal Welfare Act of 1966 as amended, may also be imposed upon any facility which sells wild animals as pets, for breeding or research purposes, or exhibits animals at any time. Annual inspection of all facilities which house such animals will be carried out

by a representative of the United States Department of Agriculture, Animal Welfare Section. For more information please contact: Eastern Regional Office for Animal Care, 920 Main Campus Drive, Suite 200, Unit 304 "0", Raleigh, North Carolina 27606 (703-812-6609).

### **QUESTIONS?**

For more information regarding the possession of wildlife, or the application and permit process, please contact: Permit Specialist, DNR, Wildlife Division, PO Box 30444, Lansing, Michigan 48909-7944 (517-373-9329).

## FROGS AND TOADS



**Common Name:** American Toad (NATIVE)

**Scientific Name:** *Bufo americanus*

**Description:** This toad is a robust animal with short legs and wide stout body. It is usually a drab brown to olive green but can contain spots of yellow or reddish coloration. American Toads can be distinguished by these spots as their darker spots can have 1-2 warts within circled by white or yellow. Large Parotid glands can be found behind the eye and enlarged warts on tibia (lower part of hind leg, below knee) distinguish American toads from some other species of toad. Their skin is warty and contains glandular secretions that can be toxic if swallowed or if it enters the eyes. Their ventral surface is white or yellow. These animals tend to be nocturnal.

**Size and Lifespan:** These toads are usually 50-120 mm in length with an average of 75 mm. They can live 10 years in the wild and can live longer in captivity.

**Natural Range:** Found in large portions of North America although they may be found as far south as Mexico. They are generally not found at the extreme ends of southern states.

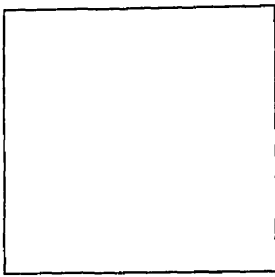
**Captive Care: Tank:** A 10 gallon tank is large enough for one adult. Increase the tank size by 5 gallons when adding each additional adult. Substrate for the tank can include soil (avoid soils with vermiculite and perlite) coconut husk fiber, cypress mulch or other substrates that allow for burrowing. Each adult needs to have a hide box. Driftwood, small plastic boxes with a hole cut out, dried leaves, flower pots or reptile hides can be used. Live plants can be added to the tank but avoid plants that have been treated with pesticides or fungicides.

**Temperature requirements:** The temperatures can range from 60-70 degree Fahrenheit. Temperatures can drop during the night below 60 degrees. **Water requirements:** These organisms can tolerate a wide range of humidity levels but it may be beneficial to create a gradient in one end of the cage by either misting or adding water to the substrate. Clean water must be available for drinking and soaking. It would be best to change this water once a day. The water should be clean of chloramines and chlorine. Spring water and bottled water can be used.

**Nutritional Requirements:** These toads will eat a wide variety of insects as well as invertebrates such as aquatic snails, earthworms, beetles and slugs in the wild. In captivity, these toads can consume crickets, waxworms, mealworms, earthworms etc. with crickets making up the bulk of its diet. They should be fed 4-6 crickets every 2-3 days. Their diet can be supplemented with worms every few weeks. Vitamin supplements can be dusted on food items 2 times weekly.

**Special Considerations:** Always wash your hands before and after handling an Amphibian. Soap, Chlorine, sunscreen and insect repellents can harm the moist permeable skin of an Amphibian. The glandular secretions of most Amphibian species will irritate the mucous membranes (mouth, eyes, and nose) of humans. This frog will escape an enclosure that does not have a tight lid.

**Video:** None at this time



**Common Name:** Dumpy Tree Frog (also known as “Australian Green”, “Giant Green” and “White’s Tree Frog” and “Smiling Frog”

**Scientific Name:** *Litoria caerulea*

**Description:** Smooth skin, color varies from jade green to bright green to olive brown (some may have a bluish cast that may be due to a dietary shortage in beta carotene), short round nose, white spotting on back, skin is resistant to desiccation (drying), large toe pads, good climbers, emits a single harsh croak as a territorial/breeding call.

**Size and Lifespan:** Males can grow up to 3.5 inches. Females may grow up to 5 inches. This is a very hardy frog that can live for 15 years or more.

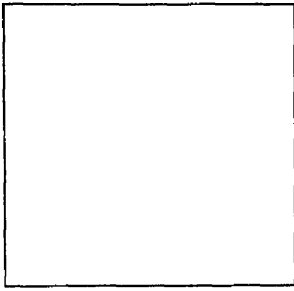
**Natural Range:** Occur throughout the Northern Half of Australia and in Southern New Guinea. They are able to live in relatively dry areas but are sensitive to cold and must be kept warm throughout the year.

**Captive Care: Tank:** A 5 gallon is fine for 2-3 juveniles however a 10 gallon is needed to house 2 adults. These frogs are arboreal so they may require a taller terrarium for climbing. **Temperature:** Temperatures should range between 77-85 degrees Fahrenheit during the daytime and 81-75 degrees Fahrenheit during night. Provide proper heat using a heat mat with thermostat. Heat mats should only cover between a third and a half of the vertical space to allow for thermoregulation. **Water requirements:** Maintain a high humidity (50-60%) by spraying vegetation often with de-ionized water. Change the water dish once a day as they like to soak. **Vegetation:** They do well with heavy foliage in their tank. Change their vegetation and foliage often so they will continue to explore their tank. They tend to be quiet, and eat readily. They generally require minimal care.

**Nutritional Requirements:** These frogs will eat crickets, mealworms and pinkie mice on occasion. Feed 4 or 5 insects per frog per feeding. They should be fed 2-3 times per week. The live food should be dusted with calcium and vitamin supplements once a week. These frogs are prone to gain weight. If the eye skin begins to fold over their eyes, reduce the amount of crickets and or pinkie mice fed to the frogs.

**Special Considerations:** Always wash your hands before and after handling an Amphibian. Soap, Chlorine, sunscreen and insect repellents can harm the moist permeable skin of an Amphibian. The glandular secretions of most Amphibian species will irritate the mucous membranes (mouth, eyes, and nose) of humans.

**Video:** <http://www.youtube.com/watch?v=R4JgD37mm78>



**Common Name:** Dwarf Underwater Frog (also called the African Dwarf Frog)

**Scientific Name:** *Hymenochirus boettgeri*

**Description:** Small aquatic, flattened and slightly rough skinned frogs that are generally olive gray containing dark spots on the dorsum. They have a small rounded snout, partially webbed digits on the forelimb and fully webbed fingers on the hind limbs with claws found on the innermost digits of each foot. Males have a small pocket of skin at the axis of each forelimb. These frogs can be sometimes confused with African Clawed frogs. African Clawed frogs can grow as large as a fist and will eat anything in sight! African Clawed frogs are often sold in pet stores as albinos and will have claw like forelimbs. They will also have eyes that are more protruded than the dwarf frogs. African dwarf frogs will often have a tiny black claw found on their back feet and webbing between the toes on their front feet.

**Size and Lifespan:** Males and Females are generally 1-1.5 inches. Females tend to be heavier bodied. The lifespan ranges from 3-5 years.

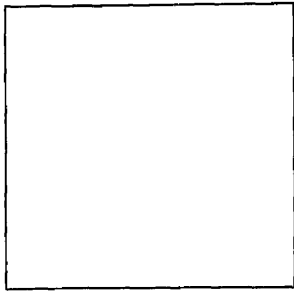
**Natural Range:** They are a tropical West African Frog although they can be found captively bred in large numbers in Asia and in summer numbers in America. They prefer shallow, heavily vegetated waters in ditches, ponds, puddles, and rice paddies. They are entirely aquatic.

**Captive Care:** **Tank:** 4-5 can live together in a 5 gallon tank. As the frogs are so small, they are not recommended to live with other organisms as they do not compete well for food. **Temperature:** Water temperatures must range between 75-82 degrees Fahrenheit. Water temperatures below 70 degree Fahrenheit can be fatal. **Vegetation:** They do best in a tank with vegetation including both rooted and floating plants. Artificial hiding areas are also recommended. Lighting for plant growth and a substrate of aquarium gravel is suggested. **Water Requirements:** Partial water changes should occur weekly and major water changes (3/4<sup>th</sup> to 7/8<sup>th</sup>) of the tank should be performed monthly. Filtration is beneficial with the water being kept free of chlorine and chloramines.

**Nutritional Requirements:** These frogs are bottom feeders. Live and frozen foods such as bloodworms, rinsed brine shrimp, blackworms, daphnia, and Cyclops can be used. Pellet food tends to be ignored. They should be fed every other day.

**Special Considerations:** Although they are aquatic organisms, these frogs can and will escape from a tank that is not covered tightly.

**Video:** <http://www.youtube.com/watch?v=tEWjYvj9gu4&feature=related>



**Common Name:** Green Treefrog

**Scientific Name:** *Hyla cinerea*

**Description:** Bright green smooth skin but can vary from brown to dark forest green with the ventral surface being white. Typically a lateral white line runs along the right and left body from the snout to the groin. It may be shorter in some populations or be absent in some populations. Gold spots may be found on the dorsal surface. Males will have a large vocal sac and will emit a nasal “onk” call. Albinos can be found in the pet trade but tend to have vision problems.

**Size and Lifespan:** These frogs can grow up to 1-2 inches with females being larger and lacking a vocal sac. They can live 6 years or more in captivity.

**Natural Range:** Can be found in southern Illinois and south to the Florida Keys and Texas.

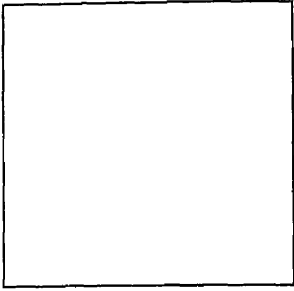
**Captive Care: Tank:** 10-gallon aquarium will be sufficient for 2-3 organisms however more space is better. As these frogs are arboreal in nature, a taller tank or terrarium is beneficial. A screen top will help with ventilation and safety. AstroTurf is suggested (or reptile carpeting) as it will not allow the organism to ingest anything while feeding. Driftwood, cork bark, sticks etc. can be used for climbing. These items should be soaked with a mild bleach solution, rinsed, dried and aerated (so that bleach fumes will not affect the organisms) before introducing them into the tank. **Temperature:** Use a under tank heating device at one end only. Place a rock or something to absorb heat at this area. A nocturnal heating lamp (not over 15 watts) can also be used. **Vegetation:** They require humid terrariums with sturdy plants for perching and concealment. Fake or live plants can be used. **Water requirements:** Terrariums should not be overly wet. Water should be changed daily. Use a spray bottle with de-ionized water to maintain humidity.

**Nutritional Requirements:** Green tree frogs will eat all types of insects however waxworms, crickets and butterworms are favorites. Feed eat adult 2-6 crickets every other day or every two days. D3-calcium powder supplement is beneficial for adults. It can be dusted on insects and administered once every 7-10 days.

**Special Considerations:** May be inactive for long periods of time (can be days). Change direction and location of foliage often to allow for exploration in their enclosure. They will huddle in groups in a cage. These organisms are nocturnal.

**Video:** <http://www.youtube.com/watch?v=LbAiPwAmSx8>





**Common Name:** Ornate Horned Frog (also called the “Argentine Horned Frog” “Horned Frog” and “Pac-Man Frog”)

**Scientific Name:** *Ceratophrys ornata*

**Description:** Large robust and flat bodied frogs with short legs and strong jaws. Their coloration is generally green with brown mottling surrounded by yellow rings. Their ‘horns’ are small skin extensions that rise from their eyes. Males have a dark throat. Albinos of this species are now common. Hybrids between the Ornate Horned Frog and the Chaco Horned frog or the Amazonian horned frog are also common.

**Size and Lifespan:** Females can reach 4-7 inches. As they are round bodied frogs, some can be wider than they are long. Males can range from 2.5-4.5 inches in length. This frog can live for 15 years or more.

**Natural Range:** This frog is found in Southern Brazil, Uruguay and Eastern-Central Argentina.

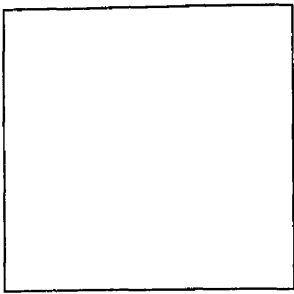
**Captive Care: Tank: Tank:** A 10 gallon tank that is terrestrial in nature (Coir or coconut substrate or sphagnum moss can be used) A plastic box for cover/hiding is necessary. Having a tank that allows for burrowing and also having a sturdy potted plant is beneficial for concealment. These animals are sit and wait predators. Their substrate should be damp but not too wet. **Temperature:** A normal 65-85 degree temperature is fine for these organisms as they are often burrowed in their cool damp substrate. **Vegetation:** A sturdy potted plant is beneficial for concealment. **Water Requirements:** Water must be changed frequently (up to 2 times daily) due to the nature of this frogs eating habits. Water should also be shallow due to the fact that they frogs cannot swim.

**Nutritional Requirements:** Ornate Horned frogs will eat a variety of prey including live fish, worms, insects and even rodents! When they consume their prey however, they can ingest portions of their substrate in their terrarium. It is best to feed your frog with forceps or to move your frog from its enclosure to avoid the swallowing of its substrate (this can cause intestinal impactions). Adults require feeding once a week and every other day for fast growing juveniles.

**Special Considerations:** This frog has teeth and will bite as it is an intense feeder. Be mindful with tools and fingers while working near or handling this frog. This frog will encase itself in a tough outer skin to protect it from drying out if water and food is scarce. They will be motionless and it may seem that they are dead. Once rehydrated, however, they will shed this outer skin and resume normal habits.

**Video:** None at this time

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**Common Name:** Red-eyed Treefrog

**Scientific Name:** *Agalychnis callidryas*

**Description:** Color may vary depending on the activity or temperature of the animal. The dorsal surface can range from olive green to bright lime green. The lateral surface can be light blue lined with white or yellow with the ventral surface being white. The hands and feet of the Red-Eyed Tree frog are orange and contain toe pads for sticking to surfaces and climbing. These frogs are nocturnal and males will produce a single note call.

**Size and Lifespan:** These tree-frogs can range from 2-3 inches in length. It may live to 10 years or more in captivity.

**Natural Range:** It can be found throughout southern Mexico through Panama.

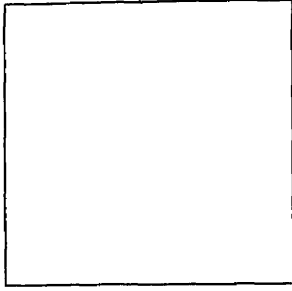
**Captive Care: Tank:** A 10- gallon tank for 1-2 tree frogs is sufficient. The nature of the tank can include damp paper towel, a shallow water dish and sturdy potted plants for simplicity or can contain a more complex set-up such as a small pond or water feature. Screen is suggested as a tank covering to allow for better ventilation. Misting of the tank and vegetation allows for more humidity. **Temperature Requirements:** Maintain day temperatures between 75-82 degrees Fahrenheit while night temperatures can range between 70-74 degrees Fahrenheit. Use a 25 watt heat lamp in well ventilated enclosures. **Vegetation:** Suggested plants include philodendron and schleffera. Sterilized driftwood can also be included for a perch. **Water requirements:** The tank should maintain a higher humidity(60% maximum) Mist every other day using only distilled water.

**Nutritional Requirements:** Invertebrate prey for feeding includes crickets and butter worms. Dusting food with calcium powder (D<sub>3</sub>) is suggested once every 10 days. Juvenile frogs can receive this powder two times every week.

**Special Considerations:** The skin of these frogs is very sensitive. Use proper hand washing technique and sterilize materials before introducing them into the enclosure. Do not use items that have been treated with insecticide or fungicide.

**Video:** None at this time

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**Common Name:** Green Frog (NATIVE)

**Scientific Name:** *Rana clamitans*

**Description:** Green frogs can range in coloration from green, yellow green, olive green or in some rare cases blue! Their bodies are marked with irregular black spots with more of a zebra type banding on the legs. They possess a distinct dorsolateral ridge running from eye down to the middle of the dorsum. Their legs are long and well adapted for jumping. Their ventral surface is white.

**Size and Lifespan:** Green frogs can range in length from 2-5 inches. Their average lifespan is unknown but they can live up to 10 years or longer in captivity.

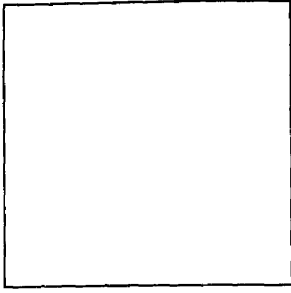
**Natural Range:** Green frogs are found in the United States throughout the East Coast including portions of Canada, the Great Lakes, Oklahoma, Eastern Texas and Florida.

**Captive Care: Tank:** A 10 gallon tank is sufficient for one organism. If keeping more than one frog, the tank should be 15-20 gallons. These organisms are semi-aquatic and should have a set-up that includes both land and water. The terrestrial side can include a mix of soil and peat moss. Sphagnum moss can also be used to cover the surface or reptile bark may be used. Plants will help to provide privacy. Make sure to use plants that have not been treated with pesticides or fungicides. Hide boxes such as flowerpots, small plastic boxes or driftwood can be used. Plexiglas can be used to divide the tank using aquarium silicone to seal the Plexiglas to the tank. A piece of driftwood can help to provide a bridge for walking from water to land. **Temperature requirements:** Temperature can range from 68-75 degrees during the day. At night it can drop to roughly 60 degrees Fahrenheit. A UVA/UVB Florescent lamp may be used to maintain temperatures. **Water requirements:** Provide the above stated aquatic environment with smooth gravel as the substrate. Change water frequently as the frogs may feed as well as soil in their water source (up to a 50% change twice weekly). Make sure the water is free of chlorine and chloramines.

**Nutritional Requirements:** These frogs will eat a wide variety of insects as well as invertebrates such as aquatic snails, earthworms, beetles and slugs in the wild. In captivity, these frogs can consume crickets, waxworms, mealworms, earthworms etc. with crickets making up the bulk of its diet. They should be fed 4-6 crickets every 2-3 days. Dusting food with calcium powder (D<sub>3</sub>) is suggested once every 10 days.

**Special Considerations:** Always wash your hands before and after handling an Amphibian. Soap, Chlorine, sunscreen and insect repellents can harm the moist permeable skin of an Amphibian. The glandular secretions of most Amphibian species will irritate the mucous membranes (mouth, eyes, and nose) of humans.

**Video:** None at this time



**Common Name:** Wood Frog (NATIVE)

**Scientific Name:** *Rana sylvatica*

**Description:** These frogs can be found in a variety of colors in the wild including brown, gray, green, tan and rust. They often have a series of dark banding patterns on their hind limbs. Most unique is a stripe of dark pigment extending from the nose, past the eye, over their tympanum and ending at the edge of their mouth. It is most often called the “robber’s mask”. They may have a white upper lip. A dorsolateral ridge will run from the eye to the hind limbs. Their ventral surface is usually yellow to greenish white.

**Size and Lifespan:** These frogs can range from 1.5 to 4 inches in length with females being larger than males.

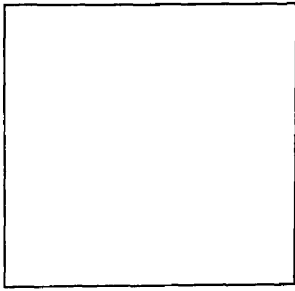
**Natural Range:** These organisms are found throughout the northeastern United States, across Canada and into Alaska as well as in northern Georgia, central Highlands and eastern Alabama.

**Captive Care: Tank:** A 10 gallon tank is sufficient for one organism. If keeping more than one frog, the tank should be 15-20 gallons. These organisms are semi-aquatic and should have a set-up that includes both land and water. The terrestrial side can include a mix of soil and peat moss. Sphagnum moss can also be used to cover the surface or reptile bark may be used. Plants will help to provide privacy. Make sure to use plants that have not been treated with pesticides or fungicides. Hide boxes such as flowerpots, small plastic boxes or driftwood can be used. Plexiglas can be used to divide the tank using aquarium silicone to seal the Plexiglas to the tank. A piece of driftwood can help to provide a bridge for walking from water to land. **Temperature requirements:** Temperature can range from 68-75 degrees during the day. At night it can drop to roughly 60 degrees Fahrenheit. A UVA/UVB Florescent lamp may be used to maintain temperatures. **Water requirements:** Provide the above stated aquatic environment with smooth gravel as the substrate. Change water frequently as the frogs may feed as well as soil in their water source (up to a 50% change twice weekly). Make sure the water is free of chlorine and chloramines.

**Nutritional Requirements:** These frogs will eat a wide variety of insects as well as invertebrates such as aquatic snails, earthworms, beetles and slugs in the wild. In captivity, these frogs can consume crickets, waxworms, mealworms, earthworms etc. with crickets making up the bulk of its diet. They should be fed 4-6 crickets every 2-3 days.

**Special Considerations:** Always wash your hands before and after handling an Amphibian. Soap, Chlorine, sunscreen and insect repellents can harm the moist permeable skin of an Amphibian. The glandular secretions of most Amphibian species will irritate the mucous membranes (mouth, eyes, and nose) of humans.

**Video:** None at this time



**Common Name:** Oriental Fire-bellied Toad (also called "Chinese fire-bellied Toads)

**Scientific Name:** *Bombina orientalis*

**Description:** Lime green to moss green dorsal surface with black mottling. The ventral surface is typically bright red with black mottling however if the diet is deficient in Beta-Carotene, the belly can be yellow or gray. The tips of the toes are red and the skin is generally warty. They can emit rapid 'hooting' type calls.

**Size and Lifespan:** Females are generally more robust than males but both sexes tend to reach approximately 1.5-1.75 inches in length. They can live for 10 or more years.

**Natural Range:** It is native to China, Korea and Manchuria.

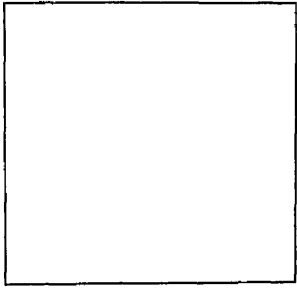
**Captive Care:** **Tank:** A 10 gallon tank is necessary for 2-3 adults. **Temperature:** Temperature should range between 75-78 degrees Fahrenheit during the day and 70-75 degrees Fahrenheit during the night. Heat should be provided using either a heat mat with thermostat, or aquarium heater with built in thermostat. Heat mats should only cover between a third and a half of the floor space to the organism for thermoregulation. **Vegetation:** The tank should be maintained as a partial aquatic set-up and terrestrial set-up. Floating plants and/or floating substrate is necessary for the toads to rest on. Moss and or sphagnum moss may be used for the terrestrial area along with soil and woodland moss. A ramp or area of stones will help your frog to leave the water. Other hardy plants for concealment are beneficial. **Water requirements:** Water should be changed once daily to decrease bacterial load. Live plants can help to increase the humidity in the tank. High humidity should be maintained by misting the tank with distilled or non-chlorinated water.

**Nutritional Requirements:** Locusts, crickets, or small pieces of earthworms can be fed to these toads 2-3 times per week. Each Toad should receive 3-4 insects per feeding. Calcium and vitamin supplements should be dusted on insects once per week. Waxworms should be given as treats only.

**Special Considerations:** The skin secretions of these toads are toxic to others and these organisms are susceptible to soap, chlorine, insect repellents and sunscreen. Therefore proper and mindful hand washing both before handling and after handling is important. Never use gravel in the terrarium set-up as it can be ingested.

**Video:** <http://www.youtube.com/watch?v=SMUiCijXtnE>

## SALAMANDERS AND NEWTS



**Common Name:** Eastern Newt (NATIVE)

**Scientific Name:** *Notophthalmus viridescens*

**Description:** This organism has 3 life stages. The life stages include larvae, a juvenile stage called the 'eft' or 'red eft' stage and the adult stage. The larvae are brown-green and possess gills. They are entirely aquatic and will not leave the water until they transform into an eft. The skin of the terrestrial eft (juvenile) is fairly bumpy and orange with distinct red spots bordered with black found in rows on its dorsum. The toe tips are black. In the aquatic adult stage, the skin is an olive brown to green but still bears the characteristic rows of red spots surrounded by black on the dorsal surface.

**Size and Lifespan:** The size can range 1.5 to 3.5 inches (juvenile size) to 2.5 to 5.5 inches in length (Adult). They can live for 20 years or more in captivity.

**Natural Range:** They can be found from Quebec to central Georgia

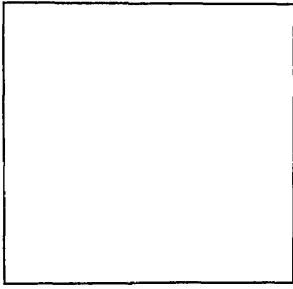
**Captive Care: Tank: (Tank set-up depends on life stage)** A 10-gallon tank will work for either 2-3 efts or 2-3 adult newts. Efts will require a tank with terrestrial substrate and an aquatic area. If efts are metamorphosing, they should be provided floating water plants in which to climb on to escape the water. The adults will require a tank with unheated water. Substrates such as small rocks/pebbles are beneficial. **Water requirements:** The adults are exclusively aquatic and require a tank that contains water that covers the organism fully. **Temperature requirements:** The water can range from 60 degrees Fahrenheit to 74 degrees Fahrenheit during the spring summer and fall. Winter temperature can be reduced to 40 to 50 degrees Fahrenheit. The warmer the temperature, the more the organisms will need to be fed. **Vegetation:** Floating vegetation helps to provide privacy as well as added beauty for the tank.

**Nutritional Requirements:** Eastern Newts can eat a variety of organisms such as chopped earthworms, frozen or live bloodworms, blackworms, or even aquatic snails. Efts will eat small earthworms, whiteworms, crickets, fruit flies, and mealworms.

**Special Considerations:** The eft will produce glandular skin secretions to ward off predators.

**Video:** None at this time

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**Common Name:** Blue-spotted Salamander (NATIVE)

**Scientific Name:** *Ambystoma laterale*

**Description:** The skin of this salamander is shiny bluish-black and will possess blue to light blue to white spots on its back, tail, and sides. They have a very long tail which is almost half (approximately 40 %) the length of its body. Their ventral surface can be black or a slightly lighter shade than its dorsum.

**Size and Lifespan:** They can range in length from 3-5.5 inches. These organisms are secretive and their lifespan is unknown.

**Natural Range:** These organisms are found throughout eastern central North America, along the east coast up into New England as well as throughout the Great Lakes area.

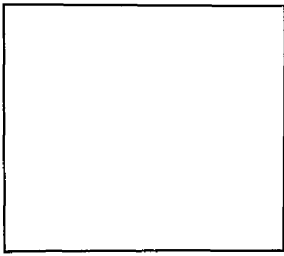
**Captive Care:** A 10 gallon tank is sufficient for one organism. If keeping more than one salamander, the tank should be 15-20 gallons. Adult organisms should have a damp terrestrial enclosure. The terrestrial set-up can include a mix of soil and peat moss. Sphagnum moss can also be used to cover the surface or reptile bark may be used. Unbleached paper towels, with crumpled pieces of moist paper towels also provide hiding areas to minimize stress. Plants will help to provide privacy. Make sure to use plants that have not been treated with pesticides or fungicides. Hide boxes such as flowerpots, small plastic boxes or driftwood can be used. Plexiglas can be used to divide the tank using aquarium silicone to seal the Plexiglas to the tank. A piece of driftwood can help to provide privacy. **Temperature requirements:** Temperature can range from 68-75 degrees during the day. At night it can drop to roughly 60 degrees Fahrenheit. A UVA/UVB Florescent lamp may be used to maintain temperatures. Temperatures should not exceed 78 degrees over an extended period of time. **Water requirements:** Change water frequently as the organisms may feed as well as soil in their water source (up to a 50% change twice weekly). Make sure the water is free of chlorine and chloramines.

**Nutritional Requirements:** This animal will eat worms, slugs, spiders, pill bugs, centipedes etc. Some captive care suggests to feed one earthworm a week. Salamanders prefer live prey as movement triggers their feeding reflex.

**Special Considerations:** These salamanders can and will walk up the glass of their enclosure. Maintain a tight lid on the cage. Do not use rocks or soil that could be ingested.

**Video:** None at this time

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**Common Name:** Axolotl

**Scientific Name:** *Ambystoma mexicanum*

**Description:** Generally olive brown to olive gray but can occur in albino (white with pink eyes) piebald (mottle with white and olive, Leucistic (pure white with dark eyes), black, gold (pink or dark eyes) Axolotl's are a completely aquatic, neotenic organism (retains juvenile characteristics of gills throughout life) They have smooth skin, a large tail/fin, lidless eyes and 3 large gills on each side of the head.

**Size and Lifespan:** Adults can range from 7-12 inches. Hatchlings range from 1-2 mm but grow quickly due to their carnivorous lifestyle. Lifespan can range from 10 – 20 years or more.

**Natural Range:** Originally found in cool lake southwest of Mexico City, these organisms now are highest in populations in captivity.

**Captive Care:** **Tank:** A 10-gallon tank works well for a single adult. Up to 12 hatchlings can live in a 5 gallon tank. **Temperature and Water Requirements:** A tank with one or more adults requires require cool water (56-72 degrees Fahrenheit) Warm water (over 77 degrees) can cause the salamander to float and allow for proliferation of skin diseases (fungus). As Axolotls breathe through gills, they require clean (ammonia, chlorine and chloramine free) cool (more dissolved oxygen) water that is well-filtered. A pH of 7.2 is ideal. 20% of water should be changed every 2 weeks. **Vegetation:** Aquarium plants are fine for addition into a tank of Axolotls. The tank can have either a bare bottom (easier for cleaning) or a substrate of sand or rocks larger than the organisms head. In this case, floating plants (Hornwort) are ideal. Check that there are no serrations to the plant leaves to ensure the safety of the animal's skin.

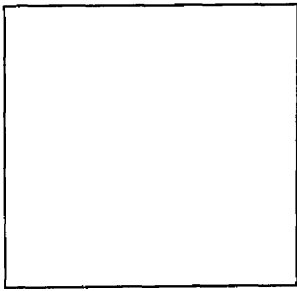
**Nutritional Requirements:** Hatchlings and juvenile require foods such as brine shrimp, daphnia, or chopped blackworms. Adults can also consume these foods or be trained to eat pellet koi food, cat chow and trout chow. Earthworms, tubifex worms (live, frozen, or freeze-dried - sometimes incorrectly labeled as "bloodworms"), bloodworms (the larvae of chironomid midges), blackworms (an aquatic relative of earthworms), crustaceans like shrimp, pieces of fish (avoid salted fish and marine fish), strips of beef heart or other lean red meat, small invertebrates like insects can also be used to feed adults. Remove any uneaten food if not eaten to maintain water quality.

**Special Considerations:** Larger salamanders can eat smaller siblings or eggs, especially if hungry. Avoid feeding frenzies but adding visual barriers between animals. Tails, limbs etc. can be nipped off however they will eventually be re-grown. Be mindful of gravel size as gravel can be ingested while feeding.

**Video:** <http://www.youtube.com/watch?v=Qtp1KABGD2U&feature=related>



## Reptiles - Turtles and Tortoises



**Common Name:** Common Musk Turtle (NATIVE)

**Scientific Name:** *Sternotherus oderatus*

**Description:** Its carapace is brown to black and is highly domed. Their skin is dark brown to black as well with yellow markings running along the head from the snout to the neck along either side of the eye. This particular musk turtle will have barbels under their throat in both males and females. Males have a larger head and a longer tail than would a female. These are chiefly nocturnal.

**Size and Lifespan:** These turtles can range in size from 3-5 inches. They can live 50 years or longer in captivity.

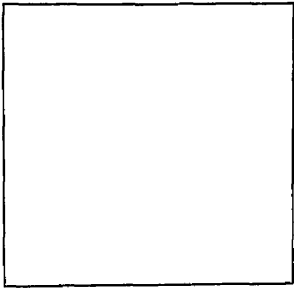
**Natural Range:** This turtle is abundant throughout the eastern coast of the United States. It can be found as far south at Florida and as far west as Texas. They are found throughout the Great Lakes region.

**Captive Care: Tank:** A 20 gallon tank is sufficient for one organism. The tank should increase in size as the organism grows. These organisms are semi-aquatic and should have a set-up that includes both land and water. The terrestrial side can include a mix of soil and peat moss. Sphagnum moss can also be used to cover the surface or reptile bark may be used. Plants will help to provide privacy. Make sure to use plants that have not been treated with pesticides or fungicides. Hide boxes such as flowerpots, small plastic boxes or driftwood can be used. Plexiglas can be used to divide the tank using aquarium silicone to seal the Plexiglas to the tank. A piece of driftwood can help to provide a bridge for walking from water to land. However many will tend to live in the aquatic side only. In this event, the tank can be full of water but a level surface should still be provided for basking out of the water. The water should not exceed 8-12 inches deep. Provide smooth gravel for substrate and water plants to help clean the water. **Temperature requirements:** Temperature can range from 75-78 degrees during the day. A UVA/UVB Florescent lamp may be used to maintain temperatures. **Water requirements:** Provide the above stated aquatic environment with smooth gravel as the substrate. Change water frequently as the turtle may feed as well as soil in their water source (up to a 50% change twice weekly). Make sure the water is free of chlorine and chloramines.

**Nutritional Requirements:** This organism is omnivorous eating worms, fish eggs, aquatic snails, some aquatic plants and even carrion. Provide such aquatic plants as duckweed and water lettuce.

**Special Considerations:** These turtles release musk when threatened or frightened. They are common called the 'stinkpot' turtles. Males are aggressive and will bite readily. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** None at this time



**Common Name:** Painted Turtle (NATIVE)

**Scientific Name:** *Chrysemys picta*

**Description:** This turtle is bright and colorful with red and yellow markings on the edge of its carapace (marginal scutes) whereas the carapace is black to greenish brown. White to light yellow markings can be found on its head. These turtles are diurnal.

**Size and Lifespan:** The size ranges from 3.5-10 inches in length. They can live 15-20 years in captivity. Some sources document its life span to range up to 35-40 years.

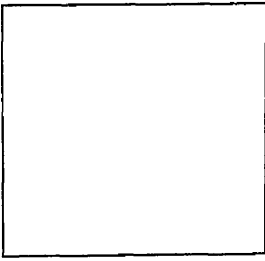
**Natural Range:** These turtles are common throughout North America and even are found in southern Canada and Northern Mexico.

**Captive Care:** A 20 gallon tank is sufficient for a hatchling but the tank must be increased as the turtle gets older. If keeping more than one turtle, the tank should be 20-30 gallons. These organisms are semi-aquatic and should have a set-up that includes both land and water. The terrestrial side can include a mix of soil and peat moss. Sphagnum moss can also be used to cover the surface or reptile bark may be used. Plants will help to provide privacy. Make sure to use plants that have not been treated with pesticides or fungicides. Hide boxes such as flowerpots, small plastic boxes or driftwood can be used. Plexiglas can be used to divide the tank using aquarium silicone to seal the Plexiglas to the tank. A piece of driftwood can help to provide a bridge for walking from water to land. However many will tend to live in the aquatic side only. In this event, the tank can be full of water but a level surface should still be provided for basking out of the water. Provide smooth gravel for substrate and water plants to help clean the water. **Temperature requirements:** Temperature can range from 75-86 degrees during the day. A UVA/UVB Florescent lamp may be used to maintain temperatures. Their basking area should range between 86 and 88 degrees Fahrenheit. **Water requirements:** Provide the above stated aquatic environment with smooth gravel as the substrate. Change water frequently as the turtle may feed as well as soil in their water source (up to a 50% change twice weekly). Make sure the water is free of chlorine and chloramines. Filtration is recommended for the water.

**Nutritional Requirements:** These turtles are omnivores eating plant matter as well as meat. They like earthworms, waxworms, fish, crickets, cooked chicken or beef and aquatic snails. Greens such as Collards, Dandelion, romaine, carrot tops, squash and green beans are great choices. Their diet should be made up of 60% greens and 40% meat. Feeding should occur every other day.

**Special Considerations:** UV light is necessary for the turtles to maintain proper calcium levels. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** <http://www.youtube.com/watch?v=2vDX6po-uCQ>



**Common Name:** Red-Eared Sliders (NATIVE)

**Scientific Name:** *Trachemys scripta elegans*

**Description:** Sliders are olive green with an oval, flattened carapace and a weak keel. They have a dark brown to black skin coloration. Most distinct is their red or orange face marking found behind each eye. The face may also have patterns of yellow markings.

**Size and Lifespan:** These organisms can range in length from 5 to 11.5 inches in length. The average life span is 30 years but has been known to live up to 42 years in the wild.

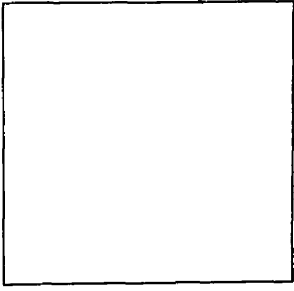
**Natural Range:** These turtles are found in the southern Great Lakes region as well as east to West Virginia. They extend their range to southeastern and south-central United States. They can be found as far south as Mexico, Central American and South America.

**Captive Care:** A 50 gallon tank is sufficient for one organism. These organisms are semi-aquatic and should have a set-up that includes both land and water. The terrestrial side can include a mix of soil and peat moss. Sphagnum moss can also be used to cover the surface or reptile bark may be used. Plants will help to provide privacy. Make sure to use plants that have not been treated with pesticides or fungicides. Hide boxes such as flowerpots, small plastic boxes or driftwood can be used. Plexiglas can be used to divide the tank using aquarium silicone to seal the Plexiglas to the tank. A piece of driftwood can help to provide a bridge for walking from water to land. However many will tend to live in the aquatic side only. In this event, the tank can be full of water but a level surface should still be provided for basking out of the water. Provide smooth gravel for substrate and water plants to help clean the water. **Temperature requirements:** Temperature can range from 75-86 degrees during the day. A UVA/UVB Florescent lamp may be used to maintain temperatures. Their basking area should range between 86 and 88 degrees Fahrenheit. **Water requirements:** Provide the above stated aquatic environment with smooth gravel as the substrate. Change water frequently as the turtle may feed as well as soil in their water source (up to a 50% change twice weekly). Make sure the water is free of chlorine and chloramines. Water filtration is recommended.

**Nutritional Requirements:** These turtles are omnivores eating plant matter as well as meat. They like earthworms, waxworms, small live fish, cooked chicken or beef (as treats only) and aquatic snails. Greens such as Collards, Dandelion, romaine, carrot tops, squash and green beans are great choices. Fruits such as berries, and apples as well as melon can help to provide variety and the rind from the melon can help to keep their beak sharp. Their diet should be made up of 50% greens and 50% meat. 25% of their meat diet can be trout chow or other prepared turtle chow. Feeding should occur every other day.

**Special Considerations:** Make sure the water is not too close to the surface of the tank. The turtles may climb out. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** <http://www.youtube.com/watch?v=zZxP6pQjnGM>



**Common Name:** Red-footed Tortoise

**Scientific Name:** *Chelonoidis carbonaria*

**Description:** Possesses a high domed and narrow carapace that is dark with light spots in the center of each scute. The scales on the forelegs may range from green with yellow to green with bright-reddish orange. The marginal scutes are not serrate. The plastron can range from yellow with a black center to black with a yellow center. The feet are red.

**Size and Lifespan:** They can vary in size depending on region. The size can range from 10 inches in length for a full-grown adult to 18 inches in length. They can live for 30 years or more.

**Natural Range:** Ranges from Panama to Argentina. It also occurs east of the Andes Mountains and may be found on some West Indian Islands.

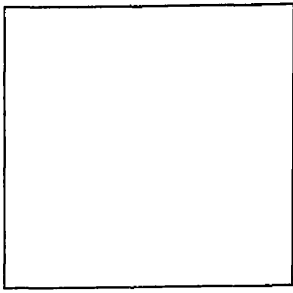
**Captive Care: Tank:** As this organism tends to walk its enclosure, a tank that is 20 gallon, long terrarium (12 x 12 x 30 inches). If available, adults should be placed in a natural enclosure that is again long and wide (up to 6 feet long by 4 feet wide). In warmer climates/Southern states, adult tortoises can be kept in a natural enclosure for up to 6 months of the year. Artificial heat may be necessary. In the north, the summer months may be the only appropriate time for outdoor living. A hiding box large enough for all tortoises to hide in is required. **Water requirements:** A shallow bowl of water that the tortoise can drink out of or immerse its feet and/or plastron is necessary. Change the water ever 1-3 days for cleanliness.

**Nutritional Requirements:** Vegetables such as romaine, carrots, dandelions, endive, clover, apples, and tomatoes (sparingly), green beans, yellow squash, zucchini, okra, collard greens are consumed. Hatchlings and ovulating females can receive vitamins 3 times weekly and adults should receive vitamins once weekly.

**Special Considerations:** Vitamin supplements should be provided to the tortoises if they are not regularly being kept outside. Calcium and vitamin D3 powder should be added to the diet. Some turtles similar to this species include the North American Wood turtle and The Eastern Box turtle. These turtles are protected by laws through their ranges in the US and ownership may be restricted (captive bred babies are often available). Check your state laws before acquiring these turtles. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** <http://www.youtube.com/watch?v=QpzQVK1wVzM>

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**Common Name:** Russian Tortoise

**Scientific Name:** *Agrionemys horsfieldii* (*Testudo horsfieldii*)

**Description:** These are robust animals with highly domed carapaces. They are light brown to tan with darker coloration found in the center of their scutes.

**Size and Lifespan:** These tortoises can range from 6-12 inches in length with males being smaller than females.

**Natural Range:** They are found in Russia, Iran, China, Pakistan, and Afghanistan.

**Captive Care: Tank:** An outdoor habitat is best for this animal. If a tank must be used, it must be large (75 gallon or above; at least 2 feet by 4 feet) containing topsoil and sand mixture as the substrate. (See below for items to include in enclosure). Indoor enclosures should also include circulating fans and visual barriers. Glass of tanks tends to create stress for this organism. The minimum size for an outdoor enclosure should be 4 feet by 4 feet with the walls of the enclosure buried 8 to 12 inches into the ground to prevent escape from digging. The walls of the enclosure should be made of wood or some other material that would prevent climbing. The enclosure should offer sunny and shady areas. Dirt, plants, flower pots, rocks and wood offer variety as well as privacy for hide boxes. Grasses, wildflowers and shrubs can be planted in the box as well. **Temperature requirements:** Their daytime temperature should range between 70-80 degrees Fahrenheit with nighttime lows of 60-65 degrees. Their basking temperature should be around 90 degrees. **Water requirements:** Water should be provided at all times for soaking and drinking. Do not let the substrate get too dry or sandy. It also should not be too wet or muddy. Humidity should be less than 40 %.

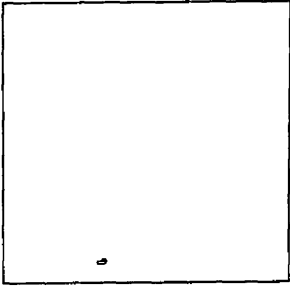
**Nutritional Requirements:** Russian Tortoises are strictly herbivorous eating plant matter only and not eating fruits. Fruits can cause diarrhea. Leafy greens that are beneficial to the tortoise includes romaine lettuce, endive, radicchio, escarole, turnip greens, kale, mustard greens, collards. A special favorite are dandelion greens. Cabbage and spring mix salad can be fed on occasion.

**Special Considerations:** Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** <http://www.youtube.com/watch?v=btXICFvLD50>

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## Reptiles - Snakes



### **Kingsnakes and Milksnakes**

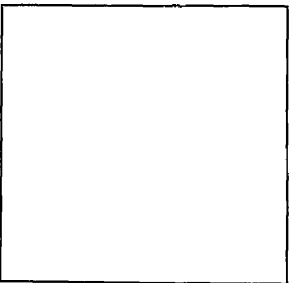
**Common Name:** California Kingsnake

**Scientific Name:** *Lampropeltis getula californiae*

**Description:** This snake is normally black or dark brown with cream or white stripes. As it has been captive bred from some time, albino, lavender and yellow are among the variations available. It has a narrow head and a large robust body.

**Size and Lifespan:** It ranges from 305 feet in length to 4.5 feet in length. They may live for 15 years or more in captivity.

**Natural Range:** It can be found in the western United States living in moderate elevations where deserts, and pine woodlands occur. It can also be found in rocky regions and trash heaps.



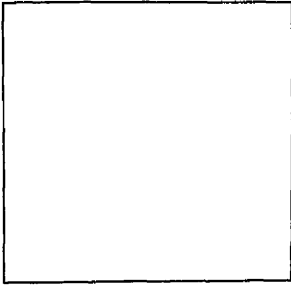
**Common Name:** Honduran Milksnake

**Scientific Name:** *Lampropeltis triangulum hondurensis*

**Description:** This is a multi-varied snake. The most typical color variation is the tricolored phase. The colors occur striped, ringed with red, yellow (white) and black. Other variations include Tangerine, (red, orange and black on orange) and Bi-colored (black and red), all of which occur in the wild. Designer colors in the pet trade include, Albino tricolor (white orange and red), albino tangerine (orange and white), hybino (rosy orange with black bands) peach, snow, (very pale) ghost (paler than the snow morph), Disappearing pattern (hazy orange red with faint black stripes) Hypomelanic (reduced black coloration), Anerythristic (dark lacking red pigment).

**Size and Lifespan:** Size can range from 4-5.5 feet in length. They can live up to 18 years.

**Natural Range:** This snake is found in many habitats of Nicaragua, Honduras and in some northeastern areas of Costa Rica. It is usually found at lower elevations



**Common Name:** Variable Kingsnake

**Scientific Name:** *Lampropeltis mexicana*

**Description:** This is a smaller snake with many variations in color. It can be commonly found as a red, black and red striped snake, with yellow to cream next to black and black next to red. Albino organisms have been documented.

**Size and Lifespan:** Adults can range in length from 26-36 inches. They can live up to 15 years or more in captivity.

**Natural Range:** This snake lives in dry rocky areas of Mexico.

**Captive Care: Tank:** A single adult will require a 20 gallon tank whereas a pair should dwell in a 40 gallon tank.

**Water requirements:** A water dish is necessary and should be changed once a day. If the snake is soaking in it, reduce the size of the dish. Being too damp can cause Vesicular dermatitis/blister disease syndrome (see special considerations below). **Temperature requirements:** The temperature should range from 70-80 degrees Fahrenheit.

**Nutritional Requirements:** California Kingsnakes can eat a variety of insects, reptiles (including other snakes) and amphibians as well as small birds, mammals especially pre-killed rodents. They are generally immune to the venom of other snakes.

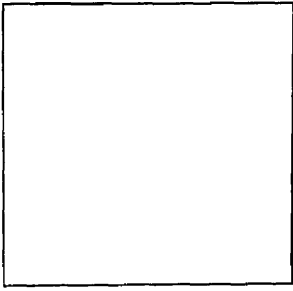
**Special Considerations:** Damp and unclean substrate/tank conditions can cause Vesicular Dermatitis infection. Blisters can form on the skin and if allowed to progress can invade and be present on internal organs. Antibiotics will be necessary. This disease is fatal. Remove young snakes from the tank as adults tend to be cannibalistic. Do not use cedar or pine as substrate. It can cause respiratory disorders

**Video:** <http://www.youtube.com/watch?v=wTrIj12vArs>

[http://www.youtube.com/watch?v=tOnA\\_bXXi5Y&feature=relmfu](http://www.youtube.com/watch?v=tOnA_bXXi5Y&feature=relmfu)

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\*The set-up for other milksnakes and kingsnakes besides the species listed here should be similar to the tank-setp described above.



**Common Name:** Eastern Garter Snake

**Scientific Name:** *Thamnophis sirtalis* (*Sirtalis sirtalis*)

**Description:** Eastern Garter Snakes tend to be mottled shades of dark green to black with a middorsal yellow to orange line running from head to tail. The body can have color variation along the sides below the middorsal line. These colors can be variable. There are 12 subspecies of this snake.

**Size and Lifespan:** The Eastern Garter Snake can range between 18-36 inches in length. Some specimens have been found up to 4 feet in length. These organisms can live 10-15 years. Some captives can live longer than 15 years.

**Natural Range:** Subspecies can be found throughout the United States including Southern Alaska, Western coast, Eastern Coast, and Southern States. They are usually absent from the western plains and desert areas.

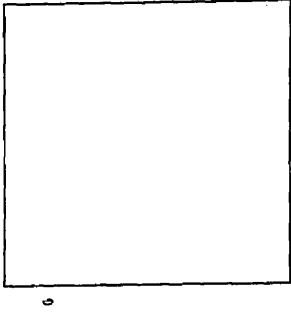
**Captive Care: Tank:** A single adult will require at least a 15 gallon tank. A pair of snakes will require a 20 gallon tank. Juveniles can live in a 10 gallon tank until they are 9 inches in length. Rocks, hide boxes and plants are beneficial as well as limbs for climbing and resting. As these snakes are occasional burrowers, make sure all terrarium objects are secure so that it does not fall and harm the snake. **Water requirements:** These snakes require a water bowl for soaking. The water must be changed often as they may stool in their water. The humidity in the cage should be high to allow for proper skin shedding. **Temperature requirements:** The cage should have a temperature gradient. The cooler end of the tank should range between 68-80 degrees Fahrenheit. The warm end of the tank should range between 85-90 degrees Fahrenheit.

**Nutritional Requirements:** As there are many subspecies, their diets vary with geographic location. Most organisms will consume worms, slugs, minnows, tadpoles, toads and frogs. Eastern subspecies prefer pinky mice however; Western subspecies may refuse this food item.

**Special Considerations:** This snake tends to be secretive and defensive if not handled frequently. Be cautious with handling until the snake is familiar with its environment and owner as it may bite. When restrained, these snakes may release stool and musk on their handlers. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** <http://www.youtube.com/watch?v=XGfK6CJukUM&feature=related>





**Common Name:** Corn Snake (Red Rat Snake)

**Scientific Name:** *Elaphe guttata*

**Description:** Coloration may vary as albinos were integrated into breeding lines. Over 30 different color variations exist. They possess a narrow head and large robust bodies. They are powerful constrictors.

**Size and Lifespan:** Adults can range from 30 to 54 inches in length. Captive Corn Snakes can live for 10 or more years. Some can live up to 20 years or more.

**Natural Range:** This is a southern snake found from New Jersey to Florida and the Keys, and west to Tennessee and Louisiana.

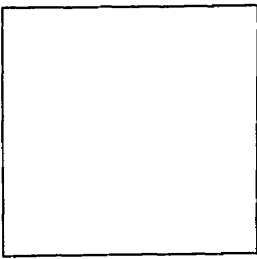
**Captive Care: Tank:** One to 2 adults may be housed in a 20 gallon tank. Juveniles may live in a 5-10 gallon tank. Substrate such as aspen or pine shavings, newspaper or dried leaves can be used. A wire lid that can clip into place is necessary as they snakes can escape readily. A hide box for each snake is essential leaning toward a box that is smaller in size but just big enough for the snake to fit. They also like to stretch out on limbs or even a shelf positioned in their cage. **Water Requirements:** A dish of water changed frequently is necessary for these snakes. **Temperature:** The temperature should range between two gradients. One end of the cage should range between 70-76 degrees Fahrenheit for snakes needing cooler temperatures. The other end should be warmer (around 88 degrees Fahrenheit). An overhead light is beneficial allowing the snake to thermoregulate.

**Nutritional Requirements:** Pre-killed mice that are fresh or frozen (but thawed) are acceptable. Active snake eat every 7-10 days.

**Special Considerations:** These snakes are constrictors that will bite when surprised or mishandled. They are also cannibalistic to young if fed in the same enclosure at the same time. Provide a visual barrier or separate adults and young when feeding. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** <http://www.youtube.com/watch?v=yqOz4mcreJg>      <http://www.youtube.com/watch?v=V0eXpNM788s>

[http://www.youtube.com/watch?v=QJIQzZlj3\\_0](http://www.youtube.com/watch?v=QJIQzZlj3_0)



**Common Name:** Central (Inland) Bearded Dragon

**Scientific Name:** *Pogona vitticeps*

**Description:** This is a varied colored lizard that can occur anywhere between tan, brown, gray, and even olive green! In the wild, the body color of these lizards in the wild tends to match the substrate where they live. Color can also vary depending on the temperature of the animal. Males often have a darkened coloration along the throat which gives them the designation of “bearded”. The face will often have bar-like markings and the body will have a middorsal shingle pattern from head to tail.

**Size and Lifespan:** Males can range in length between 16 and 22 inches. Females are usually smaller. They can live between 8 and 10 years.

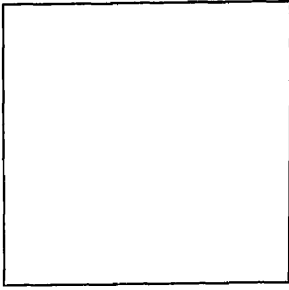
**Natural Range:** This organism originates in Australia. It is usually found in dry savanna regions.

**Captive Care: Tank:** Juveniles can be kept in a 10-15 gallon tank. Adults need lots of floor space for travel and therefore a cage that measures 18 x 36 inches for one or two dragons or a cage that measures 18 x 48 inches for 3 dragons will be necessary (50 gallons or more). Visual barriers such as rocks and plants are necessary as well as a hide box for each organism. These dragons will consume smaller animals so keep adult males together and do not introduce juveniles to the group of adults. Do not use corn or walnut cob, alfalfa pellets, kitty litter, or wood shaving for the substrate in the tank. The substrate can include large pebbles or aquarium rock although they are hard to disinfect and may cause impaction if swallowed. Properly layered sand looks best with the inclusion of non-harmful succulents, branches for climbing and hide boxes. **Temperature requirements:** The tank should be well ventilated but able to retain heat. As these organisms usually live in warm dry areas, full spectrum lighting in the tank is needed. A basking rock that ranges in temperature from 110-125 degrees Fahrenheit should be the warmest part of their enclosure. There should be a cooler end of the enclosure for thermoregulation. **Water requirements:** A shallow water bowl should be provided and can be counter-sunk into the substrate. Misting your dragon from time to time will allow them to shed easier. Do not over mist.

**Nutritional Requirements:** These lizards can eat a diet of meat, vegetable and some fruits. Plants should compose 20% of their diet. Juveniles tend to eat vegetation more readily than adults. Baby bearded dragons should not be given food larger than 2/3rds the size of their head. Adults can be fed large mealworms, cockroaches, king worms, wax worms and crickets. They will also consume fruits such as bananas, peaches, apples, mangos and other soft fruits like berries. Squash and finely chopped greens such as collards and dandelion will also be eaten. Do not feed them spinach greens. Spinach interferes with their metabolism of calcium. Do NOT feed large insects to these lizards. It can cause seizures.

**Special Considerations:** These lizards can have issues with calcium metabolism. They may require calcium supplements. D<sub>3</sub> calcium can help to supplement their diet. Provide it to adults once per week, sprinkled on food. Juveniles will require it 3 times weekly. Ensure that the calcium to phosphorus ratio is 2:1. Take care as males are very aggressive toward other males. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** <http://www.youtube.com/watch?v=rH79ReJdzd0&feature=relmfu>



**Common Name:** Fat-Tailed Gecko

**Scientific Name:** *Hemitheconyx caudicinctus*

**Description:** There are two different types of body patterns for Fat-Tailed Geckos; the banded and the striped. Each will have dark brown stripes on top of body colorations that are tan or buff. The striped body pattern will also have white vertebral stripe. The body is robust with a wide tail and short legs. It lacks toe-pad discs that are found on most geckos. Their heads are large and contain true eyelids.

**Size and Lifespan:** Males can grow up to 8 inches in length. Females are smaller than males. They can live for 10 years or more.

**Natural Range:** These organisms are found West Africa in dry and rocky woodlands and savannas. It is very secretive and tends to burrow in its substrate.

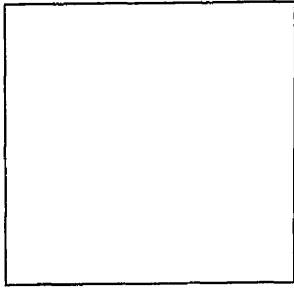
**Captive Care: Tank:** These organisms require floor space for movement. A 12 x 24 inches space is suitable for one to three Geckos. Substrate such as tree bark pieces is recommended. Hide boxes should be provided for each organism. Fill the hide box with soil or sphagnum moss to maintain proper humidity and moisture quality for the organism. **Water requirements:** Geckos require high humidity for shedding. To maintain high humidity, keep a large water dish or provide live plants for the terrarium. Do NOT mist their cage. They require a dry place to retreat to. **Temperature:** A daytime temperature of 82-90 degree Fahrenheit is required with lows during nighttime dropping 15 degrees on average.

**Nutritional Requirements:** Fat-tailed Geckos eat pinky mice as well as most types of insects. Do not feed these geckos insects or organisms that are too large. They will regurgitate them.

**Special Considerations:** Handle this organism carefully. They can squirm when held. This animal will lose its tail if it is held by its tail. The tail will regenerate but it will take time and is energy expensive for the organism. Males are extremely territorial and will attack other males. Keep them separate. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** None at this time

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**Common Name:** Leopard Gecko

**Scientific Name:** *Eublepharis macularius*

**Description:** These organisms have eyelids and are nocturnal. They lack the toe pads that are typical of other species of Geckos. Adults tend to look leopard-like with darker spots or stripes on the dorsal surface and tail with the remainder of the body a paler shade. In juveniles, the markings of brown and yellow are most distinct. It fades with age. There are now 10 different genetically designed colorations available.

**Size and Lifespan:** Leopard Geckos range between 7 and 12 inches in length. They can live between 15 to 22 years.

**Natural Range:** This gecko originates in Pakistan and India. It lives in rocky areas.

**Captive Care: Tank:** A 10 gallon tank can house one male and two females. Substrate can include pebbles and sand. Hide boxes should be provided for each organism. Desert plants are a good addition to the tank. They should remain in their pots and buried in the substrate. Use fluorescent lighting to maintain the plants.

**Temperature requirements:** Daytime temperatures should range in the 90 degree Fahrenheit range. The nighttime lows should remain in the 70's. Try to provide a temperature gradient for thermoregulation. **Water requirements:** A shallow water dish should be provided and should be changed daily.

**Nutritional Requirements:** Crickets, Mealworms and pinky mice are all highly accepted food items. D<sub>3</sub> calcium can help to supplement their diet. Provide it to adults once per week, sprinkled on food. Juveniles will require calcium powder 2 times weekly.

**Special Considerations:** Males are extremely territorial and will attack other males. Keep them separate. Check the terrarium furniture to ensure that it is anchored properly in the cage. These organisms like to burrow and cage furniture could topple and harm them. Do not use cedar or pine as substrate. It can cause respiratory disorders.

**Video:** <http://www.youtube.com/watch?v=j6LBjQQ-CeM&feature=relmfu>

<http://www.youtube.com/watch?v=lc2l5YiHZHM&feature=fvwrel>

<http://www.youtube.com/watch?v=Nnj2T4kmun0&feature=relmfu>

<http://www.youtube.com/watch?v=KwDtfiH1Xc&feature=relmfu>

<http://www.youtube.com/watch?v=TzHdYasF0T8&feature=relmfu>

# Curriculum

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1. “Love them or Leave them?” Lesson plan by Catherine Hutchings and Bridget Anderson (grades 9-10)

Reading - The Ambivalent bond with a ball of fur by Natalie Angier

In this lesson, students will reflect on their attitudes toward pets and use animal images to design an experiment identifying factors that influence humans’ attitudes, feelings and ambivalence toward animals. This lesson can be modified to discuss people’s feelings toward reptiles and amphibians versus mammals.

2. “There’s No Place Like Home?” Lesson plan by Annissa Ambouz and Bridget Anderson (grades 9-10)

Reading - To Stem Widespread Extinction, Scientists Airlift Frogs in Carry-On Bags – Brenda Goodman

In this lesson, students learn how conservationists have collected endangered frogs from a Central American rainforest in an attempt to save different species from extinction by the lethal chytrid fungus. They then take part in a “fishbowl” discussion on the various aspects of “in situ” versus “ex situ” conservation.

3. “Pet-agogy” Lesson plan by Priscilla Chan and Bridget Anderson (grades 9-10)

Reading - Venomous and Sublime: The Viper Tells Its Tale by Natalie Angier

In this lesson, students learn about interesting animal behaviors and adaptations. They then create information sheets about an animal residing in a fictional sanctuary and assess the animal’s likelihood of being a good pet.

4. “Nine Lives, One Habitat” Lesson plan by Georgia Scurletis and Bridget Anderson (grades 9-10)

Reading – Florida’s Panther Great Leap hits a wall by Mark Kerr

In this lesson, students explore the concept of the reintroduction of endangered species into new habitats. Students research and promote possible sites for reintroducing populations of Florida panthers outside of their current habitat in the Big Cypress Swamp region of southwest Florida. This lesson can be modified to reflect amphibian and reptile populations. Michigan’s Blanding’s Turtle is currently under special concern due to its declining populations. See Michigan State University Extension webpage for more information about endangered, threatened or special concern animals.

<http://web4.msue.msu.edu/mnfi/data/specialanimals.cfm>

5. "Talkin' bout Regeneration" Lesson plan by Georgia Scurletis and Bridget Anderson (grades 9-10)

Reading – Missing Limb? Salamander may have answer by Mark Pollack

In this lesson, students research the regenerative capabilities of certain organisms. They then present their findings at a "regeneration symposium" aimed at exploring the possibilities of human regeneration.

6. "Domestic Bliss in Animal Husbandry?" Lesson plan by Priscilla Chan and Yasmin Chin Eisenhaur (grades 9-10)

Reading - Future of Ancient Culture Rides on Herd's Little Hoofbeats by Amanda Leigh Haag

In this lesson, students learn about a reindeer-based ethnic group in Mongolia. They then research other examples of animal husbandry and create models to represent the relationship between a particular population of animals and humans. This lesson can be modified to reflect animal husbandry for amphibian and reptiles. The Wood Turtle is currently under special concern due to its declining populations. See Michigan State University Extension webpage for more information about endangered, threatened or special concern animals. <http://web4.msue.msu.edu/mnfi/data/specialanimals.cfm>

7. "Data sets for Animal Tracking" (grades 9-10)

In this lesson, a scientific study will be described (James et al. 2005) that shows how individual organism telemetry data was used in attempt to learn more about how to approach conservation of critically endangered Atlantic leatherback sea turtles.

8. "Frogsicles - How frogs survive the winter" Lesson plan by Emily Grman and Sara Syswerda (grades 9-10)

Includes student lab worksheet

In this lesson, students will explore how frogs survive the winter when they're frozen solid. Students will complete three short lab experiments to explore topics that help explain how frogs freeze over the winter: solute concentration, osmosis, and freezing point depression.

9. Frog Dissection – Lab – Modified from Prentice Hall Biology by Paul Duffy (grades 9-10)

In this lab, students will be able to learn about the anatomy and physiology of an amphibian through dissection of amphibians purchased from biological supply companies.

10. Frog Cell Comparison Lab (grades 9-10) by Linda Gilliam and modified by Erin Harris

- a. Students will be able to write about how an objects structure relates to its function
- b. Students will observe frog sperm, frog blood and frog skin to relate structure to function

11. What is an amphibian? Lecture and concept map by Erin Harris (grades 9-10)

Includes concept map activity and rubric

In this lecture, students will receive an introduction to what an amphibian is, how it reproduces and its role in its environment. They will create a concept map with partners to organize their information into a poster.

12. What is a Reptile? Lecture and concept map by Erin Harris (grades 9-10)

Includes concept map activity

In this lecture, students will receive an introduction to what a reptile is, how it reproduces and it's role in its environment. They will create a concept map with partners to organize their information into a poster.

13. Endangered species Research Report by Erin Harris(grades 9-10)

Includes research report rubric and graphic organizer

In this lesson, student will use computers to research an endangered amphibian or reptile of their choice. Posters can be created as a modification.

14. Vertebrate Comparison Chart by Erin Harris (grades 9-10)

In this summary chart, students will be able to compare physiology of vertebrate organisms. This summary chart works well during Taxonomy units.

## Elementary Lesson Plans

### 15. Introduction to Reptiles (grades 4-6) by Jackie Glassman

Student worksheets, surveys, and resource readings are included

In this lesson, students will understand that adaptations enable reptiles to live in their environments and that adaptations can be found in both the physical and behavioral traits of reptiles. Snakes and lizards, turtles, crocodilians, and the tuatara constitute the living orders of reptiles.

### 16. Reptile Adaptations (grades 3-5) by Jackie Glassman

In this lesson, students will be able to describe the changing traits that enable reptiles to live in their environments. Adaptations can be found in physical and behavioral traits of reptiles. Snakes and lizards, turtles, crocodilians, and the tuatara constitute the living orders of reptiles.



## Love Them or Leave Them?

By **CATHERINE HUTCHINGS** and **BRIDGET ANDERSON**

*Note: This lesson was originally published on an older version of The Learning Network; the link to the related Times article will take you to a page on the old site.*

Teaching ideas based on New York Times content.

**Overview of Lesson Plan:** In this lesson, students will reflect on their attitudes toward pets and use animal images to design an experiment identifying factors that influence humans' attitudes, feelings and ambivalence toward animals.

### Author(s):

Catherine Hutchings, The New York Times Learning Network

Bridget Anderson, The Bank Street College of Education in New York City

**Suggested Time Allowance:** 1 hour

### Objectives:

Students will:

1. Reflect on the spectrum of attitudes people have toward common pets.
2. Learn about the human relationship with animals by reading and discussing the article "The Ambivalent Bond With a Ball of Fur."
3. Design a research experiment to study the opposing forces of connectedness and tension humans have with animals.
4. Analyze experiment data and write a formal conclusion on the results.

### Resources / Materials:

-pens/pencils

-classroom board

-student journals

-copies of the article "The Ambivalent Bond With a Ball of Fur," found online at

[http://www.nytimes.com/learning/teachers/featured\\_articles/20071002tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20071002tuesday.html) (one per student)

-resources to obtain photos of animals and pets, such as online sources, magazines, newspapers

### Activities / Procedures:

1. **WARM-UP/DO NOW:** Prior to class, instruct students to bring to class a photo of their pet. Students who do not have pets could bring a photo of their ideal pet or a family member's pet. As students bring in their photos, post them on a wall or bulletin board.

At the beginning of class, ask students with pets to briefly describe their pet, their relationship to it and their feelings towards it. On the board, record descriptive phrases students use to describe their relationship to their pets, such as "member of the family", "fun companion", "don't pay any attention to

it” or “annoying responsibility”.

In their journals, have students arrange the comments along a spectrum with negative comments on one end and positive comments on the other end. Then, have students draw small pictures of a dog, cat, fish, snake, horse, guinea pig, hamster, etc. at the place on the spectrum that best describes their attitude toward this animal.

Invite students to share their rankings and discuss the following question: “Is it possible to have ambivalent feelings toward an animal, such as to both adore it and resent it at the same time? Why or why not?”

2. As a class, read and discuss the article “The Ambivalent Bond With a Ball of Fur”

([http://www.nytimes.com/learning/teachers/featured\\_articles/20071002tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20071002tuesday.html)), focusing on the following questions:

- a. What does the writer, Natalie Angier, mean by the “specificity” of grief?
- b. In your opinion, why is the number of households with a pet on the rise?
- c. According to Dr. Hauser, what is the source of human’s ambivalence and tension with animals?
- d. What scientific knowledge was gained by the relationship between Dr. Pepperberg and Alex the African gray parrot?
- e. How would you summarize the theme of the article?
- f. In what ways do we “anthropomorphize” our pets?
- g. Do you agree that humans “want to feel justified in using animals”?
- h. What is meant by Ms. Angier’s phrase, “reaching beyond the parochial barriers of the human race to commune with other species”?

3. Explain to students that they will be designing an experiment that uses photographs of animals to learn more about the “ambivalent bond” that people have with animals and pets (if necessary, review the definition of “ambivalent”). The goal: to gather concrete data on the emotions that people feel toward animals, focusing on where the tipping point is between our feelings of connectedness and our feelings of tension, as described in the article by Dr. Marc Hauser: “On the one hand, we feel a connection to other animals and we can’t imagine a world where we’re the only species on the planet. On the other hand, we’re always trying to show that we’re not animals. We’re like them, yet we don’t want to be like them.” Where do humans draw the line between adorable pet and exposable research subject? Between food source and feathered friend? Between mangy mutt and adoptable pup? Between chew-up-my-new-shoes trouble that’s worth it and Trouble that’s worth gifting millions of dollars?

Begin by dividing students into small groups. Explain that groups should first discuss Dr. Hauser’s statement and brainstorm a list of factors that affect whether we feel connected to an animal or feel tension with it. Factors include intelligence, cuteness, size, “ick factor,” reputation and many others. Have groups use this list of factors to create possible research questions. For example, students might ask: Is the connection we feel toward certain animals based on their perceived intelligence? How does an animal’s “cuteness factor” affect our connectedness to it? Explain that groups must each select one research question.

After groups have chosen a question, they will make a research plan. Part of the research plan must include an animal photo slide show, consisting of either electronic pictures or a flip book of printed color photographs. As they create their slideshows, remind students that they should keep other variables — such as size of photo, background design, captions, special effects and audio cues — consistent throughout the entire show to avoid biasing the viewer. The selection of images, the way they are presented and the type of feedback gathered for each picture is extremely important. Instruct students that they will need to carefully gather a variety of photos that represent the entire spectrum of possible responses.

Students should use the following guiding questions (copied into a handout) when designing their experiment:

- What is your research question or problem?
- Is your question clearly stated and researchable through the use of animal photos?
- What is your preliminary hypothesis?
- What sort of feedback (data) can you gather from your audience about the photos? What kind of feedback would be most useful?
- What methods (yes/no questions, written descriptions, ordered choices) will you use to get useful data?
- What instructions will you give the audience or what specific questions will you ask them?
- What kinds and how many photos will you need?
- How will you analyze the data you collect?

If students are having trouble designing their experiments, provide help by discussing different ways they could gather data. For example, students posing the question “What characteristics determine whether or not a dog is adoptable?” might simply show photos one by one to a series of viewers and have them individually write down adjectives to describe the animal. They could also ask each person to pick one dog he or she would want to adopt. They could then tally the frequency of each adjective by dog and compare them to the most desired dog. They might also categorize adjectives as positive, negative, neutral or unsure based on previously agreed-upon criteria. They would count the types of comment for each picture and then look for commonalities between the photos that received highly positive remarks.

Or students could ask a series of yes/no questions to focus on one specific factor affecting adoption, as follows: “Would you adopt this dog for \$400? \$300? free? Would you adopt this dog if it were in a “high-kill shelter”? if it were going to be euthanized in 10 days? five days? tomorrow?” etc. For each photo, students could then compare the dogs people were willing to pay the most for with those they would pay the least for.

Alternatively, students may wish to use an “eye doctor” procedure, individually testing a group of people: As an eye doctor would flip between two different visuals to narrow down a patient’s exact prescription, students could ask people to select between options, selectively narrowing down the choices making it harder and harder to make the choice between adoptable and not. Groups could provide each test subject with a list of possible reasons for their choice, ask him or her to state one

reason for each choice as they go through the exercise, and then rank the dogs and the reasons each person stated for his or her choice.

Provide time for students to design a plan, create a slide show and decide how they will collect and analyze data. In order to verify that students are gathering useful data, it may be helpful to have groups try out their plans on each other.

Once groups have completed their projects, have them present their slide show and gather data from another class. Students should collect data from a sample size of at least 10 people. If desired, you may divide a cooperating class into survey groups and have two or three different surveys happening at once. Before the end of class, make sure that groups have compiled data and that each student has copied it into their journals for the homework.

4. WRAP-UP/HOMEWORK: Individually, students analyze and draw conclusions from their data. Explain that students should create a visual representation of their data, in the form of a chart or graph, and write a formal conclusion statement of one to two paragraphs. Provide the following questions as a handout for students to address when writing the conclusion:

-Was your hypothesis supported, negated or neither?

-Did your methodology produce sound and reliable results? If not, how would you change your experiment?

-What did you learn about the “ambivalence” between people and animals from your experiment? What new questions, if any, have arisen from your research?

**Further Questions for Discussion:**

-How do think people’s attitudes toward animals will change in the next 50 years, if at all, and why?

-How do you feel about the trend of bringing small dogs everywhere?

-What is your stance on animal testing? Do you believe it is cruel or a necessary part of modern medicine and research? Why?

**Evaluation / Assessment:**

Students will be evaluated based on participation in the initial exercise, thoughtful participation and discussion of the article, research plan and written analysis of data and ability to draw conclusions from the results.

**Vocabulary:**

ambivalent, intensity, specificity, catastrophic, rhythms, assumptions, unmet, antidote, paradoxically, surrogate, loco parentis, parochial, commune, species, condolences, nuzzle, ambivalence, tension, self-defense, justified, grotesque, morphologies, fiscal, attribute, daffy, gingerly, anthropomorphize, euthanize, resent

**Extension Activities:**

1. Using the conclusions of your experiment, write a list of suggestions to a group that would find them useful, such as an animal shelter or pet store.
2. Research the methods researchers use to teach animals to communicate with humans. For example,

how did Dr. Pepperberg train Alex the African gray parrot to talk? How did researchers teach Koko the gorilla sign language? How do trainers teach sea lions, dolphins, elephants, and killer whales to perform? Could you use similar methods to train your pet to do something? Try it and find out.

3. What is the difference between pets and working animals? For example, people use seeing-eye dogs, rescue dogs, security dogs, police dogs, and therapy dogs. Invite someone who trains or works with a “working dog” to visit your class.

4. Write a journal entry about your habits with your pets. Like Ms. Angier, does your cat lie in the warm laundry? What ways, if any, do you spoil them? When do you most look forward to seeing them?

5. Interview a vet about how people cope with the loss of a pet. How does he/she deal with this part of their job? What recommendations do they have for people who have an aging pet? Make a brochure that informs people about what to expect.

6. Ask for student opinions on groups like PETA that oppose any animal testing. Make a poster anonymously quoting the range of opinions you found.

### **Interdisciplinary Connections:**

**American Studies** – How does the places of pets in American lives today compare to the places they held during different time periods? Interview different generations of your family to learn how our views of animals have changed over the years. Tell a story about an animal from these varying perspectives.

#### **Economics**

-Invent a new pet product or toy. Who is your target audience? How will you market it? How much will you charge for it? Make a prototype, create a business plan, or design an advertisement for your product.

-What is the financial cost of having a pet? Gather estimates for vet fees, food, grooming, habitat, accessories, and vacation accommodations. Make a poster making people aware of the financial obligations of owning a pet.

**Fine Arts** – Make a collage that describes emotions and feelings toward animals. What negative or positive feelings do people have about animals? How might people feel differently toward a certain animal, like snakes?

**Global Studies** – How do opinions and attitudes toward animals in different countries and cultures compare? Use online resources to find out whether common beliefs about people and animals in different countries are true. Share your results with the class.

**Teaching with The Times** – For one week, review articles from the New York Times related to the full range of how humans treat animals. Then write an op-ed (opinion-editorial) article based on what you learned. To order The New York Times for your classroom, click here.

### **Other Information on the Web:**

The American Pet Association (<http://www.apapets.org/>) is a national humane organization offering services and resources to humane societies, veterinarians, breeders and pet owners.

Pet Station (<http://www.petstation.com/>) is a guide to natural and enlightened pet-keeping, featuring sections on birds, dogs, cats, fish, amphibians and reptiles, horses, and other critters.

## **Academic Content Standards:**

### **Grades 6-8**

Behavioral Studies Standard 1- Understands that group and cultural influences contribute to human development, identity, and behavior. Benchmark: Understands that each culture has distinctive patterns of behavior that are usually practiced by most of the people who grow up in it

Behavioral Studies Standard 2- Understands various meanings of social group, general implications of group membership, and different ways that groups function. Benchmark: Understands how language, literature, the arts, architecture, other artifacts, traditions, beliefs, values, and behaviors contribute to the development and transmission of culture

Science Standard 12- Understands the nature of scientific inquiry. Benchmarks: Knows that there is no fixed procedure called "the scientific method," but that investigations involve systematic observations, carefully collected, relevant evidence, logical reasoning, and some imagination in developing hypotheses and explanations; Establishes relationships based on evidence and logical argument

Science Standard 14-Understands the nature of scientific knowledge. Benchmark: Understands that questioning, response to criticism, and open communication are integral to the process of science

Science Standard 15- Understands the nature of scientific inquiry. Benchmarks: Understands the nature of scientific explanations; Knows that scientific inquiry includes evaluating results of scientific investigations, experiments, observations, theoretical and mathematical models, and explanations proposed by other

### **Grades 9-12**

Behavioral Studies Standard 1- Understands that group and cultural influences contribute to human development. Benchmark: Understands that cultural beliefs strongly influence the values and behavior of the people who grow up in the culture, often without their being fully aware of it, and that people have different responses to these influences

Behavioral Studies Standard 2- Understands various meanings of social group, general implications of group membership, and different ways that groups function. Benchmark: Understands that social groups may have patterns of behavior, values, beliefs, and attitudes that can help or hinder cross-cultural understanding

Science Standard 12- Understands the nature of scientific inquiry. Benchmarks: Knows that scientists conduct investigations for a variety of reasons; Knows that investigations and public communication among scientists must meet certain criteria in order to result in new knowledge and methods

Science Standard 14-Understands the nature of scientific knowledge. Benchmark: Knows that scientific explanations must meet certain criteria to be considered valid

Science Standard 15- Understands the nature of scientific inquiry. Benchmark: Knows that conceptual principles and knowledge guide scientific inquiries (historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists)

## The Ambivalent Bond With a Ball of Fur

By NATALIE ANGIER

A couple of weeks ago, while I was out of town on business, our cat, Cleo, died of liver failure. My husband and daughter buried her in the backyard, not far from the grave of our other cat, Manny, who had died just a few months earlier of mouth cancer.

Cleo was almost 16 years old, she'd been sick, and her death was no surprise. Still, when I returned to a home without cats, without pets of any sort, I was startled by my grief — not so much its intensity as its specificity.

It was very different from the catastrophic grief I'd felt when I was 19 and my father died, and all sense, color and flooring dropped from my days. This was a sorrow of details, of minor rhythms and assumptions that I hadn't really been aware of until, suddenly, they were disrupted or unmet. Hey, I'm opening the door to the unfinished attic now. Doesn't a cat want to try dashing inside to roll around in the loose wads of insulation while I yell at it to get out of there?

I've just dumped a pile of clean laundry on the bed and I'm starting to fold it. Why aren't the cats jumping up for a quick sit? Don't they know everything is still warm?

We expect the bonds between children and parents, or between lovers or close friends, to be fierce and complex, and that makes them easy to understand. We expect the bonds between people and their pets to be simple and innocent, an antidote to human judgment and the fog of human speech, and that can make the bond paradoxically harder to track or explain. How do we feel about the nonhuman animals whose company we crave? We think we know. Our pet is our "best friend," a "member of the family," a surrogate child for the adults, in loco parentis for the kids and the best possible pillow for whoever has first dibs.

Pets are growing ever more popular. In 1988, according to the American Pet Products Manufacturers Association, 56 percent of American households had a pet. By 2006, that figure had climbed to 63 percent, which works out to a national census of 88 million owned cats, 75 million dogs, 16 million birds, 14 million horses, 142 million fish, assorted small mammals and the occasional leopard or Madagascan hissing cockroach.

We love our pets and we love the idea of pets, of reaching beyond the parochial barriers of the human race to commune with other species. When Alex the African gray parrot, renowned for his ability to communicate, do simple arithmetic and describe objects by their color, size, shape and material, died last month of cardiovascular disease at the age of 31, his obituary appeared everywhere, and Irene Pepperberg, the scientist who had trained Alex since 1977, was flooded with condolences.

"Alex touched so many people," Dr. Pepperberg, a lecturer and research associate at Harvard University,

said in a telephone interview. "He broke all preconceived notions of what it means to be a bird brain." She admitted to feeling devastated. "There's a parrot-size hole in my life," she said.

Yet part of the reason Alex's death attracted so much sympathy, and why Dr. Pepperberg's grief seems normal rather than excessive, is that Alex, in the public eye, was neither pet nor ordinary parrot. He was Pinocchio, striving to realize his full potential — his humanity. Importantly, Alex didn't merely nuzzle his affection for Dr. Pepperberg. He had genuine dying words, the fine four-hanky phrase, "I love you."

By contrast, when Leona Helmsley, the hotel magnate who died in August, specified in her will that she was leaving \$12 million to her pet dog, Trouble, while stiffing two of her grandchildren, there was scant talk of dogs as best friends. There were hoots, clucks and growls, with one reader on The New York Times Web site advising the grandchildren to "go kill that stupid dog."

Marc Hauser, professor of psychology at Harvard and author of "Wild Minds: What Animals Really Think," says ambivalence and tension have long been woven into our feelings about animals. "On the one hand, we feel a connection to other animals and we can't imagine a world where we're the only species on the planet," he said. "On the other hand, we're always trying to show that we're not animals. We're like them, yet we don't want to be like them."

Dr. Hauser traces this tension to self-defense. We use animals, and we want to feel justified in using animals. We eat their muscles for meat, flay their hides for shoes and accessories, inject them with experimental vaccines, genetically engineer them into grotesque morphologies to study human diseases. This requires a certain mental distance.

So we adore our pets and lavish time and money on them. Annual pet expenditures in this country have doubled in the last decade and are now more than \$40 billion a year. And then we scold ourselves for our foolish fiscal priorities.

We adore our pets and can come to identify with them so deeply that we attribute to them some truly daffy notions, like the radio listener who called in a comment to Colin Allen, a philosopher and cognitive scientist at Indiana University's Center for the Integrative Study of Animal Behavior. "She wanted to tell me about how her cat had very gingerly brought in an injured bird to show her, as though to say, It's hurt, please take care of it," Dr. Allen said. "I suggested there might be other interpretations for her cat's behavior."

Yes, we love our pets and anthropomorphize them to the point where we think our cat might enjoy wearing the mouse hat Halloween costume now on sale at PetSmart.com. And still we abandon difficult pets, and shelters euthanize some 10 million pets a year.

I understand the ambivalence of the human-animal bond. I loved my cats, and I miss them, but I resent them, too, for showing me what a creature of small habits I am, and for reminding me that even love is not enough. Life, like the laundry, will always cool down.



## **There's No Place Like Home?**

**By ANNISSA HAMBOUZ and BRIDGET ANDERSON,**

*Note: This lesson was originally published on an older version of The Learning Network; the link to the related Times article will take you to a page on the old site.*

Teaching ideas based on New York Times content.

**Overview of Lesson Plan:** In this lesson, students learn how conservationists have collected endangered frogs from a Central American rainforest in an attempt to save different species from extinction by the lethal chytrid fungus. They then take part in a “fishbowl” discussion on the various aspects of “in situ” versus “ex situ” conservation.

### **Author(s):**

Annissa Hambouz, The New York Times Learning Network

Bridget Anderson, The Bank Street College of Education in New York City

**Suggested Time Allowance:** 1 hour

### **Objectives:**

Students will:

1. Consider some of the ways species become endangered or extinct.
2. Learn about the rescue and conservation of Central American rainforest frogs by reading and discussing “To Stem Widespread Extinction, Scientists Airlift Frogs in Carry-On Bags.”
3. Research and take part in a fishbowl discussion on “ex situ” and “in situ” methods of conservation.
4. Write a creative journal account from the perspective of a scientist working to save an endangered species from extinction.

### **Resources / Materials:**

-student journals

-pens/pencils

-paper

-classroom board

-copies of “To Stem Widespread Extinction, Scientists Airlift Frogs in Carry-On Bags” found online at [http://www.nytimes.com/learning/teachers/featured\\_articles/20060606tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20060606tuesday.html) (one per student)

-photographs or illustrations of five to six endangered species, each threatened by a different anthropogenic or natural source

-computers with Internet access

### Activities / Procedures:

1. WARM-UP/DO-NOW: Before class, post photographs or illustrations of five to six endangered species (each threatened by a different anthropogenic or natural source), around the classroom. As students enter class, direct their attention to the images. What do they think these animals have in common? Briefly review the distinctions among “threatened,” “endangered,” and “extinct” species, before having students respond to the following prompt in their journals (written on the board prior to class): “Why do some animal species become endangered or extinct? Make a list of causes, both anthropogenic (human-made) and natural.”

Allow students a few minutes to write, and then have them share their responses as you note them on the classroom board. Some examples of anthropogenic, or human-made, causes include: poaching (hunting), land development, deforestation, and air pollution, among others. Examples of natural causes include: disease, natural disasters, drought, and erosion, among others.

Finally, have students return to the images on the classroom wall, and discuss the causes for each species’ endangered status.

2. As a class, read and discuss the article “To Stem Widespread Extinction, Scientists Airlift Frogs in Carry-On Bags” ([http://www.nytimes.com/learning/teachers/featured\\_articles/20060606tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20060606tuesday.html)), focusing on the following questions:

- a. What did airport security discover when they searched the carry-on bags of conservationists from Atlanta, according to the article?
- b. Why were these scientists transporting frogs?
- c. Where did the frogs live before their rescue?
- d. What is “El Valle”?
- e. How does the chytrid fungus work, and what are its effects on infected animals?
- f. How did scientists know where the fungus would strike next, according to the article?
- g. By what methods did the scientists capture and contain the frogs?
- h. What special accommodations have scientists made in order to allow the captive frogs to survive outside of their natural habitat?
- i. What is meant by the expression “rapid response protocol”?
- j. Why did some scientists object to the strategy by which the frogs were rescued and moved into captivity?

3. Explain to students that this article raises the question of “in situ” versus “ex situ” conservation. According to the Australian Government’s Biodiversity Theme Report Glossary, in situ conservation means conserving the threatened or endangered species in its natural habitat, while ex situ conservation sustains the species outside of its natural environment in facilities such as zoos, aquariums, and botanical gardens. In the case of the frogs of El Valle, most scientists felt there was no other choice but to carry out the “mass frog evacuation” and relocate the amphibians to their Atlanta institutions. While there are challenges and benefits to both types of conservation, it will be the students’ task to investigate these aspects further before taking part in a “fishbowl” discussion.

Divide students into six groups and designate three groups as “in situ” and three as “ex situ.” Using all

available classroom sources, groups conduct research on their assigned type of conservation.

Recommended online resources include the Conservation International's "Biodiversity Hotspots" page (<http://www.biodiversityhotspots.org/xp/Hotspots>). Groups should focus their research on the following questions (written on the board for easier student access):

- How would you define your type of conservation?
- What are some examples of your type of conservation (either general or specific projects, organizations, institutions, or facilities)?
- What are some benefits and drawbacks to this type of conservation, and why?
- What species have been saved by this type of conservation?
- Do any statistics or other data support the use of this type of conservation?

Once groups have completed their research, students should "jigsaw" into new groups, each one with two members from each research group. Members of the new group share information on both in situ and ex situ findings so that all students in the new group develop a better understanding of both types of conservation.

Next, have students number off one to five, then keep a list on the board of all "1's," "2's," "3's," "4's," and "5's." Ask all "1's" to sit facing one another in the middle of a circle created by the rest of the students. The students in the center are the only ones allowed to speak. If a student from the outer circle wants to add to the discussion, he or she moves to the middle of the circle, taps a participant to indicate that he or she should resume a place in the outer circle, and takes that student's place as the new person in the discussion. After discussing the first question, switch the students in the center to all "2's," and allow the same fishbowl procedure to occur. Be sure to switch topics enough times so that all students have the opportunity to be in the center of the discussion at least once.

Depending on the focus of your curriculum, suggested questions to pose to students include, but are not limited to:

- In what situations do think ex situ conservation is the only option for a species' survival?
- What are the benefits of ex situ conservation?
- What aspects of the species' ecosystem or habitat are lost if the only method of conservation is ex situ?
- For what reasons would in situ conservation be necessary, and why?
- When extinction is a possibility, is in situ or ex situ preferable, and why?
- How might the type of threat (anthropogenic or natural) influence the decision to use in situ or ex situ conservation?
- How can ex situ conservation work in conjunction with in situ conservation?

4. WRAP-UP/HOMEWORK: For homework, each student responds to the following essay prompt:

"Choose an endangered species and write a journal account about how, as a member of a team, you are working to save this animal from extinction. Use the information you gathered in class and discussed in the fishbowl to support your work."

#### **Further Questions for Discussion:**

- Were you surprised to learn that the entire amphibian class is under the threat of extinction by the

chytrid fungus? Why or why not?

-Do you support the “rapid response protocol” used by the scientists in the article, or do you agree with Dr. Wake, that more organized thought should be given to “captive breeding”? Why?

#### **Evaluation / Assessment:**

Students will be evaluated based on their written responses to the initial task, participation in class discussion and group research, and creative responses to the homework prompt.

#### **Vocabulary:**

Rifle, amphibians, encroaching, lethal, conservationists, swaddled, insidious, waterborne, keratin, respiration, sloughs, taxonomic, declines, extinctions, moral, ethical, evacuation, captivity, humidifier, vapor, lien, triage, validation

#### **Extension Activities:**

1. Compare the lethal chytrid fungus discussed in this article to other species-threatening diseases, such as the devil facial tumor disease, avian influenza, bovine spongiform encephalopathy, and others. Make a comparative chart with descriptions of the ailments, the species at risk, the global regions affected, and the numbers of deaths attributed to these diseases.

2. Learn more about the chytrid fungus, and what to do if you encounter an amphibian afflicted with this disease. Create a poster providing the public with crucial information to help prevent it from spreading. You may wish to begin your research at the “Frog Chytrid Fungus” page of the Australian National Parks and Wildlife Services Web site

(<http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Frog+Chytrid+fungus>).

3. Amphibians are known as an “indicator species.” What does this mean, and what are some other classes of animals designated as such? Create a guide to “indicator species.”

4. The article mentions that the entire class of amphibians may be at risk of extinction. Which subclasses and species fall under this category? Create a taxonomic chart.

#### **Interdisciplinary Connections:**

Civics- Create a timeline of United States government legislation to protect endangered species, starting with the Endangered Species Act of 1973.

Economics- How are zoos funded? How much does it cost annually to maintain a zoo? Interview a local zoo director, or visit the San Diego Zoo Web site ([www.sandiegozoo.org](http://www.sandiegozoo.org)) to start your research. Publish your findings in your local or school newspaper.

Teaching with The Times- Create a journal compiled of endangered species articles from The New York Times. Categorize these stories taxonomically, or by type of threat (human or natural).

To order The New York Times for your classroom, click [here](#).

#### **Other Information on the Web:**

The National Parks and Wildlife Services Web site contains a page

(<http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Frog+Chytrid+fungus>) with detailed information and related links on the chytrid fungus and its impact on the global frog population.

**Academic Content Standards:**

**Grades 6-8**

Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows ways in which species interact and depend on one another in an ecosystem; Knows that all individuals of a species that occur together at a given place and time make up a population, and all populations living together and the physical factors with which they interact compose an ecosystem; Knows factors that affect the number and types of organisms an ecosystem can support; Knows relationships that exist among organisms in food chains and food webs

Science Standard 9- Understands the basic concepts of the evolution of species. Benchmark: Understands the concept of extinction and its importance in biological evolution

Science Standard 16- Understands the scientific enterprise. Benchmark: Knows ways in which science and society influence one another

Geography Standard 8- Understands the characteristics of ecosystems on Earth’s surface. Benchmarks: Understands the functions and dynamics of ecosystems; Understands ecosystems in terms of their characteristics and ability to withstand stress caused by physical events

Geography Standard 14- Understands how human actions modify the physical environment. Benchmarks: Understands the environmental consequences of people changing the physical environment; Understands the environmental consequences of both the unintended and intended outcomes of major technological changes in human history

Geography Standard 18- Understands global development and environmental issues. Benchmarks: Understands how the interaction between physical and human systems affects current conditions on Earth; Understands why different points of view exist regarding contemporary geographic issues

Language Arts Standard 1- Demonstrates competence in the general skills and strategies of the writing process. Benchmarks: Uses style and structure appropriate for specific audiences and purposes; Writes persuasive compositions; Writes compositions that speculate on problems/solutions

Language Arts Standard 4- Gathers and uses information for research purposes. Benchmarks: Uses a variety of resource materials to gather information for research topics; Determines the appropriateness of an information source for a research topic; Organizes information and ideas from multiple sources in systematic ways

**Grades 9-12**

Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years; Knows ways in which humans can modify ecosystems and cause irreversible effects

Science Standard 9- Understands the basic concepts of the evolution of species. Benchmark: Knows how natural selection and its evolutionary consequences provide a scientific explanation for the diversity and

unity of past and present life forms on Earth

Science Standard 16- Understands the scientific enterprise. Benchmark: Knows that science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen

Geography Standard 8- Understands the characteristics of ecosystems on Earth's surface. Benchmarks: Understands how relationships between soil, climate, and plant and animal life affect the distribution of ecosystems; Knows ecosystems in terms of their biodiversity and productivity; Knows the effects of biological magnification in ecosystems; Knows the effects of both physical and human changes in ecosystems

Geography Standard 14- Understands how human actions modify the physical environment. Benchmarks: Understands the role of humans in decreasing the diversity of flora and fauna in a region; Understands the global impacts of human changes in the physical environment

Geography Standard 18- Understands global development and environmental issues. Benchmarks: Understands why policies should be designed to guide the use and management of Earth's resources and to reflect multiple points of view; Understands contemporary issues in terms of Earth's physical and human systems

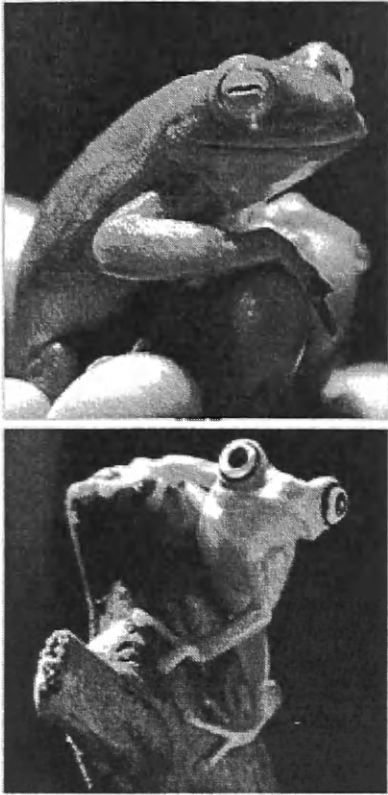
Language Arts Standard 1- Demonstrates competence in the general skills and strategies of the writing process. Benchmarks: Writes compositions that are focused for different audiences; Writes compositions that fulfill different purposes; Writes persuasive compositions that evaluate, interpret, and speculate about problems/solutions and causes and effects; Writes reflective compositions

Language Arts Standard 4- Gathers and uses information for research purposes. Benchmarks: Uses a variety of news sources to gather information for research topics; Synthesizes information from multiple research studies to draw conclusions that go beyond those found in any of the individual studies

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## To Stem Widespread Extinction, Scientists Airlift Frogs in Carry-On Bags

By BRENDA GOODMAN



Erik S. Lesser for The New York Times

A Canal Zone tree frog, top, and a lemur leaf frog, above, were among the specimens that Joseph R. Mendelson and Ron Gagliardo took from Panama.



Top, Erik S. Lesser for The New York Times; Ron Gagliardo/Atlanta Botanical Gardens

Dr. Mendelson and Mr. Gagliardo examine a giant fringe-limbed tree frog, top. The frogs filled their carrying case.

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ATLANTA, June 5 — Of all the things airport security screeners have discovered as they rifle through travelers' luggage, the suitcases full of frogs were a first.

In a race to save amphibians threatened by an encroaching, lethal fungus, two conservationists from Atlanta recently packed their carry-ons with frogs rescued from a Central American rain forest — squeezing some 150 to a suitcase — and requested permission from airlines to travel with them in the cabin of the plane.

The frogs, snugly swaddled in damp moss in vented plastic deli containers big enough for a small fruit salad, were perhaps the last of their kind, collected from a pristine national park that fills the bowl of El Valle, an inactive volcano in Panama.

In many parts of the world, habitat loss is thought to be the biggest driver of amphibian extinctions, but the frogs in El Valle are facing a more insidious threat.

A waterborne form of chytrid fungus is marching down the spine of the mountain range where they live. Scientists aren't exactly sure how the fungus, *Batrachochytrium dendrobatidis*, kills, but it seems to break down a protein in the skin called keratin that may be important for respiration. The skin of



infected animals sloughs off in layers, and within two weeks, they die.

The chytrid fungus is thought to play a large role in the worldwide disappearance of amphibians, a trend terrifying to experts, who say it would be the first loss of an entire taxonomic class since the dinosaurs.

Joseph R. Mendelson, curator of herpetology at Zoo Atlanta, who has discovered some 50 new species of frogs only to watch half of them become extinct in the last 15 years because of the fungus, was tired of watching helplessly as salamanders, newts and frogs were eradicated from one patch of forest after another.

With the help of new data published on Feb. 28 in The Proceedings of the National Academy of Sciences by Karen R. Lips, a zoologist at Southern Illinois University who spent years tracking the chytrid fungus, scientists were able to predict where it would next strike.

"When you can make predictions with respect to catastrophic population declines and extinctions, we all agreed you have a moral and ethical responsibility to do something about it," Dr. Mendelson said.

Dr. Lips called Dr. Mendelson and Ron Gagliardo, the amphibian conservation coordinator at the Atlanta Botanical Garden, because the men have a reputation for being especially good at catching and taking care of frogs, and proposed an idea that would seem reckless to most biologists.

She wanted them to collect as many frogs of as many different species as they could and move them out of El Valle before the virus hit. She estimated they had only weeks to carry out the mass frog evacuation.

"We are going to over-collect hundreds of animals," Dr. Mendelson said. "That flies in the face of all conservation logic."

There was no time to do the meticulous studies of behavior, reproduction, eating habits and habitat that zoologists try to conduct before moving any endangered species from its natural environment.

There was not even time to figure out where to keep hundreds of frogs.

"Years and years of work go into moving one species out of the environment," Dr. Mendelson said. "We decided that can't happen. There's no time for that. We had to figure out what could be done quickly and, of course, legally."

They went into the forest at night, since most frogs are nocturnal, slogging down a river in hip waders and carrying powerful flashlights. After four separate trips, some lasting only 48 hours, the two men, along with a native guide who possessed stealth and fast hands, managed to gather 600 frogs, shooting for 20 males and 20 females of each species to ensure good genetic variation in their breeding colonies.

To feed them, they rented a house and left piles of rotting fruit in the corners to attract flies. "It was pretty stinky," Mr. Gagliardo said.

Then there were those trips through airport security.

A guard in the Panama City airport was not satisfied with the letters of explanation the biologists

presented, even though they included permission from the Panamanian government to collect the frogs.

He had them open a container that held the Michael Jordan of jumpers, a species the biologists liked to call rocket frogs.

"I open it and, sure enough, the frog goes bing!" Dr. Mendelson said.

Fortunately, Mr. Gagliardo caught it before it landed on anyone in the amazed crowd that had gathered.

Many of the species they brought home to their respective institutions in Atlanta have never before been kept in captivity.

But Mr. Gagliardo, who has been bringing frogs home since he was 4 years old, has developed a fine touch for their husbandry and for recreating environments for them to thrive and breed.

He quickly realized, for example, that a translucent species of frog collected from a cloud forest wasn't breeding because it needed, well, clouds.

With a cool-misting humidifier he bought on eBay and some plastic pipe, Mr. Gagliardo filled the glass frogs' tank with a steady whisper of white water vapor. Once the tank, which sits in a corner of a behind-the-scenes room at Zoo Atlanta, was bubbling over with a creeping mist like a witch's cauldron, tadpoles followed in short order.

"It's a bit of a Noah's Ark, in some ways," Mr. Gagliardo said. "But it gives these species that are predicted to go a new lien on life."

Not all experts, it should be noted, are fans of what has come to be called the rapid response protocol.

Dr. David Wake, an integrative biologist at the University of California, Berkeley, said the strategy felt too much like triage.

"I am alarmed at the apparent disappearance of so many amphibians in Central America," Dr. Wake said. "But if the situation is so bad then much organized thought should be given to a plan for captive breeding that is not responsive to emergencies only, but that looks at all amphibians worldwide to decide where limited funds would be best spent."

Not all species are equally valuable, he noted, and not all are equally at risk.

Still, in an apparent validation of their tactics, Dr. Mendelson said the chytrid fungus had recently been found in El Valle, as predicted, and he estimated 90 percent of the frogs there would be gone within 90 days.

"You won't hear scientists say this too often," Dr. Mendelson said. "But I wish we were wrong."

## **Pet-agogy**

**By PRISCILLA CHAN and BRIDGET ANDERSON**

*Note: This lesson was originally published on an older version of The Learning Network; the link to the related Times article will take you to a page on the old site.*

Teaching ideas based on New York Times content.

**Overview of Lesson Plan:** In this lesson, students learn about interesting animal behaviors and adaptations. They then create information sheets about an animal residing in a fictional sanctuary and assess the animal's likelihood of being a good pet.

### **Author(s):**

Priscilla Chan, The New York Times Learning Network

Bridget Anderson, The Bank Street College of Education in New York City

**Suggested Time Allowance:** 45 minutes – 1 hour

### **Objectives:**

Students will:

1. Generate questions and observations about snakes.
2. Learn about new insights into snake behavior by reading "Venomous and Sublime: The Viper Tells Its Tale."
3. Research and create animal information sheets to help operate a fictional animal sanctuary.
4. Assess the viability of keeping some of these animals as pets by writing and attaching disclaimers to the information sheets developed by classmates.

### **Resources / Materials:**

- student journals
- pens/pencils
- paper
- classroom blackboard
- copies of "Venomous and Sublime: The Viper Tells Its Tale" (one per student) See link here: [http://www.nytimes.com/learning/teachers/featured\\_articles/20021210tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20021210tuesday.html)
- markers/crayons
- resources about a variety of animals (computers with Internet access, encyclopedias, animal guides, periodicals, library resources, etc.)

### **Activities / Procedures:**

1. WARM-UP/DO NOW: Students respond to the following prompt in their journals (written on the board prior to class): "You have decided that you would like to have a snake for a pet. What five

questions do you think would be the most important questions to ask the pet store owner prior to making your purchase? For each question, explain why you feel that this knowledge is important to have.” After a few minutes, allow students to share their responses. Which questions relate to the snake’s behaviors? Which relate to how to take care of the snake?

2. As a class, read and discuss the article “Venomous and Sublime: The Viper Tells Its Tale,” focusing on the following questions:

- a. For what reasons do people find snakes fascinating?
- b. What types of snakes are included in the family of vipers?
- c. What is the identifying characteristic of all vipers?
- d. What examples of snake behavior did the herpetologists who wrote “Biology of the Vipers” describe?
- e. Why might a young viper be in danger when it is shedding its skin? How does this affect the amount of parental care given to baby vipers?
- f. What type of experiment did Dr. Randall S. Reiserer design? What was his conclusion about the ability of vipers to acquire new behaviors?
- g. What is the special adaptation of the hime-habu viper? How does that allow it to better survive in its environment?
- h. What is meant by the term “adaptive constipation”? Of what benefit is it for a snake to retain its feces?
- i. Why do herpetologists call the number of rattlesnake bites in the country “illegitimate”? How prone are snakes to biting?

3. Explain to students that they have just been hired to work at a new sanctuary for animals from all over the world which are no longer wanted by their owners. The “clientele” includes rare and exotic pets and animals used for research or entertainment, such as pigs, killer whales, pythons, alligators, tigers, lions, elephants, chimpanzees, piranhas, prairie dogs, insects, spiders, wallabies, honeybees, and other species. Working alone or in pairs, students should each choose one animal that would be at this sanctuary (from the list provided or of their own choosing) and use all available resources to develop an information sheet that addresses the following (written on the board for easier student access):

- Provide a physical description of the animal. Include an illustration.
- Describe the ideal habitat for the animal.
- Give examples of habits or behaviors that are characteristic of the animal.
- List typical foods in the diet of the animal.
- Describe the life cycle of the animal. Include information about mortality rates, reproductive frequencies and level of parental care.
- Estimate the geographic distribution and natural population of the animal. Include a map of where this animal is found in the wild.
- Assess the animal’s behaviors both in the wild and in captivity. Describe any health concerns or social interaction difficulties that occur, either with humans or other animals.

After research is complete, each student or pair should develop an information sheet for the sanctuary that incorporates all of their research.

4. WRAP-UP/HOMEWORK: Students or pairs should exchange information sheets with another student or pair. Explain that in order for the sanctuary to remain operational, it maintains an adoption program to generate revenue. Using the information on the sheet, students will serve as safety specialists for the sanctuary and assess the animal's potential as a safe pet. They will then write and attach disclaimers to the information sheet. Disclaimers should address the following concerns: ease and cost of maintaining the animal, ability to replicate a comfortable animal habitat and possible disruptions to the animal's natural behavior due to captivity. Students should share their responses in a later class and post their information sheets and disclaimers in the room.

**Further Questions for Discussion:**

- What are other definitions of the word "viper"? How does that word association affect how the public views snakes?
- There are many titles of items in popular culture that use the word "viper" in their name, such as a car called the Dodge Viper, a television show called Viper, and a security system called Viper. Why do you think the word "viper" is used in such a way? What other animals have products that use their names to portray an image?
- Can any animal be kept as a pet? What rights do animals have when they are held in captivity?
- What is the difference between a pet and an animal that is kept a zoo?

**Evaluation / Assessment:**

Students will be evaluated on initial journal responses, thoughtful participation in class discussions, extent and accuracy of animal research, factuality and design of animal information sheets, and analyses of various animals' potentials as pets.

**Vocabulary:**

dappled, glower, evocative, preposterous, galumph, mesmerized, outcropping, ectotherm, sinusoidal, concave, erectile, palate, posterior, herpetologist, basking, susceptible, undulatory, primatologist, hypothermal, preferentially, prowess, nocturnal, regurgitate, metabolic, defecate, inert

**Extension Activities:**

1. Research why some scientists propose changing the term "cold-blooded" to "ectothermic" and "warm-blooded" to "endothermic." Research the definitions of these new terms, and choose one animal from each category. Investigate how each animal survives because of its ectothermic or endothermic adaptations. Write a revised chapter for an elementary science textbook that explains these new definitions.
2. Define how some species are classified as r-selected or K-selected. Choose an animal and research its parental and reproductive behavior. Predict if the animal is r-, K- or a combination of both r- and K-, and write a defense of the prediction. Then, research and confirm or refute your guess, and write an assessment of the accuracy of your prediction.
3. Come up with operational definitions for mammals, reptiles, amphibians, fish and birds. List animals that fall into each category. Then, research examples of animals that do not fall exclusively into one

category, such as the duck-billed platypus, echidna and red-back salamanders. Describe these exceptions, and propose new operational definitions for the categories in light of these differences.

4. Visit the zoo, park or other location with animals, including homes or classrooms with pets, and observe a creature for ten minutes. Record all the animal's actions and the duration of each activity. Write a field journal entry describing the animal and predict whether it would demonstrate the same behavior during a different time of day. If possible, observe the animal at a different time and confirm your prediction.

### **Interdisciplinary Connections:**

**Current Events-** Identify how prevalent non-native animal species are in the United States. Research how such species affect ecosystems and how wildlife management officials manage their spread. Consider the zebra mussel in the Great Lakes since 1989, the West Nile Virus from mosquitoes since 1999, and the snakehead fish in Maryland since 2002. Write an editorial urging the public to be cautious when traveling or accepting shipments from overseas. Give examples of the types of adverse effects that non-native species have on indigenous flora and fauna.

**Economics-** Analyze the black market trade in exotic animals and related products. Research specific examples such as poaching for elephant tusks, rhinoceros horns and shark fins. Write a policy paper on how effective law enforcement is in stemming this trade. Describe, using supply and demand graphs, how this trade is spurred by market rates.

**Global Studies-** Select an animal that has special meaning for a particular group of people, such as polar bears to the Eskimos, elephants to Southeast Asian cultures or bald eagles to North Americans. Research how this meaning affects how these animals are viewed and treated. Write an insert to a travel guide that describes this treatment to potential visitors.

**Language Arts-** Research colloquial definitions of animal names such as snake, rat, pig, fox and hound. Also explore how certain vocabulary words are designed to dehumanize some animals, like the use of "cattle" or "veal" to describe cow commodities. Write an essay that analyzes how associated word definitions affect a person's perception of the animal itself compared with the person described as being like the animal or the commercial use of the animal.

**Technology-** Read about the American Zoo and Aquarium Association's Species Survival Plan (<http://www.aza.org/species-survival-plan-program/>) and investigate the reproductive technology utilized to identify what animals have the greatest potential for breeding and producing offspring. Write a fundraising letter to persuade patrons to contribute to improve technology for these efforts. Describe the benefits and difficulties in maintaining species diversity and longevity.

### **Other Information on the Web:**

Venomous.com (<http://www.venomous.com/>) provides information and pictures of venomous snakes.

Nature: Victims of Venom (<http://www.pbs.org/wnet/nature/victims/>) explores how venomous snakes and sea creatures use poison as a survival tactic.

## Academic Content Standards:

### Grades 6-8

Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows ways in which species interact and depend on one another in an ecosystem; Knows that all individuals of a species that occur together at a given place and time make up a population, and all populations living together and the physical factors with which they interact compose an ecosystem; Knows factors that affect the number and types of organisms an ecosystem can support; Knows relationships that exist among organisms in food chains and food webs

(CTSS – 'science', '6-8', '7')

Geography Standard 8- Understands the characteristics of ecosystems on Earth's surface. Benchmarks: Understands the distribution of ecosystems from local to global scales; Understands the functions and dynamics of ecosystems; Understands ecosystems in terms of their characteristics and ability to withstand stress caused by physical events; Knows changes that have occurred over time in ecosystems in the local region; Knows the potential impact of human activities within a given ecosystem on the carbon, nitrogen, and oxygen cycles

(CTSS – 'social', '6-8', 'geo3')

### Grades 9-12

Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years; Knows ways in which humans can modify ecosystems and cause irreversible effects

(CTSS – 'science', '9-12', '7')

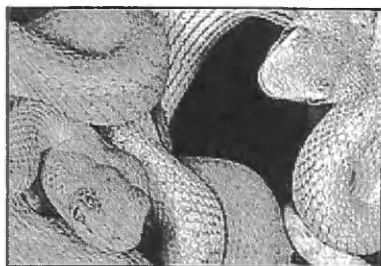
Geography Standard 8- Understands the characteristics of ecosystems on Earth's surface. Benchmarks: Understands how relationships between soil, climate, and plant and animal life affect the distribution of ecosystems; Knows ecosystems in terms of their biodiversity and productivity and their potential value to all living things; Knows the effects of biological magnification in ecosystems; Knows the effects of both physical and human changes in ecosystems

(CTSS – 'social', '9-12', 'geo3')

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## Venomous and Sublime: The Viper Tells Its Tale

By NATALIE  
ANGIER



William B. Love for The New York Times

McGregor's pit vipers from the Philippines. The pit, between snout and mouth, enables the snake to pick up heat signals from prey and foe.

Not long ago in Zion National Park in southern Utah, a couple of hikers — O.K., one of them was this writer — came upon a big and handsome Western rattlesnake off to the side of the trail. The snake was coiled on a rocky outcropping just below eye level, sunning itself, as ectotherms love to do. A dappled velvet cable at home on the checkerboard stage of the desert.

Soon, a throng of other hikers had gathered round to gawk, leaning in to take pictures and then squealing excitedly as the snake snapped its head toward a camera flash with a withering glower. When a park ranger arrived to see what the fuss was about and said yes, it was a real rattlesnake with genuine venom in its fangs, a teenage girl in the throng breathed out a sentiment surely shared by the group: "That is so cool! I've never seen one of these things outside a zoo before."

Is there anything cooler than a snake or more evocative of such a rich sinusoidal range of sensations? Snakes are beckoning. Snakes are terrifying. Snakes are elegant, their skins like poured geometry.

Snakes are preposterous. Just watch one galumph its jaws around a stunned hare or a chicken egg or even another snake.

Around the world, people dream of snakes more than of any other animal. As scientists learn more about the biology, evolution and behavior of these earthiest and most Freudianized of creatures, snakes just keep getting cooler, a fitting fate for a coldblooded reptile.

Lately, biologists have been particularly mesmerized by the large, ancient and wildly diverse group of snakes called the vipers, a family that includes rattlesnakes, coral snakes and black mambas and more than 200 other species dispersed across every continent, save Australia.



Some, like the rattlesnake, are pit vipers, with specialized concave pits between the snout and mouth that pick up heat signals from prey and foe alike. Others are pit-free.

Many New World vipers have elaborate rattles, a posterior shingling of fingernail-like plates that can shake a warning at 50 beats a second.

All vipers, however, are equipped with their signature erectile fangs, a cleverly designed set of daggerlike venom delivery devices that lie flat against the snake's upper palate when the mouth is closed, but that pop out to unexpectedly nightmarish dimensions when the snake is poised to strike.

Whereas most snakes lay eggs, a great majority of vipers give birth to live young, a fact reflected in the family name, taken from the Latin words *vivo*, meaning live, and *partus*, birth.

The vigor of the viper calling is shown in "Biology of the Vipers," a generously illustrated volume being published by Eagle Mountain Publishing. In it, several dozen herpetologists offer an array of surprising, amusing and cautionary findings about their snakes.

They describe hawkish vipers and stalker vipers, males that devote the bulk of their mating energy to fighting other males and males that opt instead to pester a female, tailing behind her, interfering with her hunting and otherwise preventing her from choosing another forked tongue in the road.

They talk, as well, of the sweeter side of serpenthood, of vipers that seem to recognize their kin and seek out their siblings preferentially when it is time to den down and curl up for the winter; and of mothers that are anything but coldhearted.

Dr. Harry W. Greene of Cornell and his co-workers describe cases of parental behavior among black-tailed and pygmy rattlesnakes that defied all their presumptions.

"We'd expected that after giving birth the mothers would crawl one way and the babies another," Dr. Greene said. "But instead, we'd find a mother basking with her young day after day or guarding the entrance to a burrow while the babies were inside." Once, he said, he saw a little viper start to emerge from its hole, apparently against its mother's better judgment. "She put her head on him and nudged him back inside."

The researchers propose that parental behavior has evolved among some vipers, together with delayed skin shedding. While most baby snakes shed their skins as soon as they are born, viper newborns, which are comparatively larger, do not discard their birthday suits until they are about 10 days old. While they are shedding that skin, their eyes are beclouded, they are susceptible to water loss, and they are extremely vulnerable. Hence the need for a mother's watchful care.

Though snakes have long been viewed as little more than preprogrammed pinheads — "pretty low on the totem pole in intelligence," as one herpetologist put it — Dr. Randall S. Reiserer of Vanderbilt University in Nashville tenders evidence that vipers can in fact learn from experience and fine tune their hunting strategies to suit new circumstances.

He took 10 young massasauga vipers into his laboratory, some from swampy regions of the Eastern United States and others from the Arizona deserts. As a rule, Eastern massasaugas lure fast-moving

frogs by giving undulatory wiggles of their tail, which resembles a worm. But when they see a slower-moving lizard, they do not risk a tail nip and instead pursue on their bellies.

Western massasaugas, by contrast, are faced with fast-darting desert lizards. So they use their tails as lures, while they ignore the few frogs in the area as too toxic.

Dr. Reiserer showed that despite their different origins Western vipers could learn to hunt like Easterners, with tail wagging for frogs and pouncing on slow lizards, and Easterners could be trained to wag for lizards and eschew frogs.

"Snakes turn out to be very complicated creatures," he said. "But they have few ways to express what they know. It's easy to underestimate a tube."

"We're becoming more like primatologists in our thinking," said Dr. Gordon W. Schuett of Georgia State University and Zoo Atlanta, an editor of the new book. "We're tracking individual snakes for long periods of time to see who they hang out with and whom they might even form pair bonds with."

Beyond behavioral findings, herpetologists also continue to be impressed by viper physiology. Dr. Akira Mori of Kyoto University and his colleagues describe the hypothermal prowess of the hime-habu, a short stout-bodied nocturnal viper that does not recoil from the cold, found on Okinawa and other islands of the Ryukyu Archipelago.

As ectotherms, snakes depend on heat from the outside to warm their bodies and allow them to move, hunt and digest the fruit of that hunt. When the temperature falls below 50, most snakes are virtually immobilized. If they have food in their bellies, they have to regurgitate it, for they can no longer digest the prey and could end up dying from the effects of rotting flesh within. Snakes that live in cold climates hibernate on empty bellies through the winter.

The hime-habu viper, however, has evolved the ability to continue feeding in spurts from December through March, even when temperatures dip into the 40's. With that capacity, unrivaled among vipers and, possibly, among all snakes, the hime-habu can take advantage of a rich source of food unexploited by competing reptiles, two species of frogs that gather near mountain streams by the hundreds for a few frenzied days of breeding.

Dr. Mori and his co-workers found that the vipers somehow knew exactly when the frog fest was scheduled and that they appeared at the right spot at the right time and then quickly gulped down five or more frogs in an evening. They spend the next couple of weeks digesting the meal, despite the measurable chilliness of their bodies.

Somehow, perhaps because their venom is especially suited to help process frog meat or because they have evolved mechanisms yet to be determined that keep their metabolic fires stoked in the absence of external heat, the snakes do just fine when they dine.

"You won't find a group of snakes that's more ecologically diverse and evolutionarily fascinating than the vipers," Dr. Jonathan A. Campbell of the University of Texas at Arlington said. "The northernmost snake in the world is a viper, which is found in the Arctic Circle, in Scandinavia. The southernmost snake is also a viper, living in Patagonia. The two snake species that live at the highest elevation in the world are both

vipers, one in the Himalayas, another in the mountains of Mexico. And their beauty? Even those who don't like snakes have to admit their beauty." That serpentine beauty, though, may be only skin deep.

Dr. Harvey B. Lillywhite and his co-workers at the University of Florida in Gainesville describe their discovery in a number of viper species of what Dr. Lillywhite has termed "adaptive constipation." They report that, among some of the ground-dwelling vipers, defecation is a shockingly rare event. Gaboon vipers of Africa, for example, will go for a year or more without disposing waste, even as they continue to feed regularly on rodents, a retention feat that may be the longest in the animal kingdom. By contrast, Dr. Lillywhite said, semiarborescent vipers defecate in a more timely fashion after a meal, usually in a few days, if not hours.

Ground-dwelling vipers store up so much offal, the researchers calculated, that their body mass ends up being as much as 20 percent fecal matter, the vast bulk of it concentrated in the posterior. Unlike cases of pathological constipation that afflict other animals, including humans, the snakes show no ill effects, no vomiting and no signs of septicemia.

Dr. Lillywhite suggests that a land-based viper retains feces because it is a great ballast. It helps anchor the lower body to the ground and thus enables the snake to strike its head out toward prey with great speed and accuracy. Tree-dwellers, by contrast, can use a branch to steady themselves.

Best of all, feces is metabolically inert. Extra muscle, bone or fat require energy to sustain them, while feces sits there for free.

Snakes, as it happens, are sublimely inert themselves, spending less than 5 percent of their lives in motion. For all their fearsome reputation, vipers do not bite unless they really have to.

Three-quarters of the rattlesnake bites in this country are described by herpetologists as "illegitimate," a result, according to Dr. Erika Nowak of the Southwest Biological Science Center of the United States Geological Survey, "of people who knew what they were doing, who knew that they were dealing with a rattlesnake but just kept poking it or picking it up or bothering it repeatedly."

Dr. Nowak, whose center is in Flagstaff, Ariz., labors mightily to convince people that having a rattlesnake in the neighborhood is not a menace. Rattlesnakes go to great lengths to avoid biting people or having anything to do with them at all. Even stepping on a rattlesnake is usually a nonevent, and most people have no idea when they have done it, she said.

The site where she conducts her research, the Montezuma Castle National Monument in Arizona, has a "healthy" rattlesnake population, 75 to 100 snakes a square mile. About a million people a year visit the monument, she said. Yet in the nine years that she has worked there, two people have been bitten, and one was somebody working for her.

Dr. Nowak strives to improve the rattlesnake's image to limit the number of people who call the authorities and demand that a "nuisance" snake in their vicinity be moved elsewhere. Her research has shown that moving snakes far from their homes almost never works. Much of the time, the snakes die as a result. In other cases, they simply return, traveling miles over a period of months or years, until they find their way home, where all they want to be is left alone.

## **Nine Lives, One Habitat**

**By GEORGIA SCURLETIS and BRIDGET ANDERSON**

*Note: This lesson was originally published on an older version of The Learning Network; the link to the related Times article will take you to a page on the old site.*

Teaching ideas based on New York Times content.

**Overview of Lesson Plan:** In this lesson, students explore the concept of the reintroduction of endangered species into new habitats. Students research and promote possible sites for reintroducing populations of Florida panthers outside of their current habitat in the Big Cypress Swamp region of southwest Florida.

### **Author(s):**

Georgia Scurletis, The New York Times Learning Network

Bridget Anderson, The Bank Street College of Education in New York City

**Suggested Time Allowance:** 45 minutes – 1 hour

### **Objectives:**

Students will:

1. Speculate about why the Florida panthers' geographic range has changed in the past 500 years.
2. Learn about past and current efforts to preserve the endangered Florida panther population by reading and discussing "Florida Panther's Great Leap Hits a Wall." See link here:  
[http://www.nytimes.com/learning/teachers/featured\\_articles/20021015tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20021015tuesday.html)
3. Research potential sites for new populations of Florida panthers to be reintroduced.
4. Synthesize their understanding of evaluating potential sites for reintroducing Florida panthers by creating promotional brochures of sites that highlight the advantages of those areas.

### **Resources / Materials:**

- copies of maps that display the changes in size of the Florida panthers' habitat (one per small group), to be downloaded and printed from the Florida Fish and Wildlife Conservation Commission's Web site ([http://www.floridapanther.net/index.php/handbook/history/range\\_of\\_the\\_florida\\_panther/](http://www.floridapanther.net/index.php/handbook/history/range_of_the_florida_panther/))
- copies of a map of southwestern Florida (one per small group), to be downloaded and printed from the Florida Fish and Wildlife Conservation Commission's Web site (<http://myfwc.com/research/gis/>)
- pens/pencils
- paper
- classroom blackboard
- copies of "Florida Panther's Great Leap Hits a Wall" (one per student)
- four slips of paper or index cards, each containing the name of a possible site for reintroducing a Florida panther population (the Apalachicola National Forest in the Southern panhandle; the Osceola National Forest and Okefenokee Swamp in North Florida and South Georgia; national forests in Arkansas and Mississippi; Ocala National Forest in Central Florida)

-resources for researching various ecosystems in the southeastern region of the United States (geography textbooks, encyclopedias, almanacs, computers with Internet access)

**Activities / Procedures:**

1. WARM-UP/DO-NOW: Prior to class, arrange desks into small groupings. On one desk in each grouping, place a copy of a map that displays the changes in size of the Florida panthers' habitat from 1500 A.D. to the present (printed from the Florida Fish and Wildlife Conservation Commission's Web site at ([http://www.floridapanther.net.org/index.php/handbook/history/range\\_of\\_the\\_florida\\_panther/](http://www.floridapanther.net.org/index.php/handbook/history/range_of_the_florida_panther/))). Write the following prompt on the board for small groups to discuss upon entering class: "Look at the map that your group has been given. How has the geographic range of the Florida panthers' habitat changed from its original size? What circumstances do you think have contributed to this change?" After a few minutes, have each small group share their responses with the class. Then, have students view a map of southwestern Florida, where the current population of Florida panthers lives (<http://myfwc.com/research/gis/>) Based on their observations of this map, why might the current population of Florida panthers be isolated in this region?
2. As a class, read and discuss "Florida Panther's Great Leap Hits a Wall," focusing on the following questions:
  - a. According to the article, what two major forces isolated the current Florida panther population to the Big Cypress Swamp region of southwest Florida?
  - b. What is the current "peril" endangering Florida panthers that is ironically due to the success of biologists' efforts to save them from extinction?
  - c. Why can the Big Cypress Swamp region only accommodate about "100 or so" panthers?
  - d. According to the article, what were the physical effects of inbreeding within the Florida panther population?
  - e. What type of "genetic experiment" was performed in order to save the Florida panther population from the damaging effects of inbreeding?
  - f. Why does Dr. David S. Maehr think that "crossbreeding has gone too far" in the case of the Florida panthers?
  - g. Why are there panther monitoring flights three times a week in the Big Cypress Swamp region?
  - h. According to Mr. Land, what are signs that indicate that the Florida panther population in the Big Cypress Swamp region is nearing saturation?
  - i. Why does Dr. Kasbohm speculate that the Florida panther may never be removed from the endangered species list?
3. Explain to students that today they will be acting as evaluators of potential sites for new populations of Florida panthers to be reintroduced, since their current habitat in southwestern Florida has almost reached its saturation point. Divide students into four groups, and have each group select a slip of paper or index card containing the name of a possible site for reintroducing a Florida panther population (the Apalachicola National Forest in the Southern panhandle; the Osceola National Forest and Okefenokee Swamp in North Florida and South Georgia; national forests in Arkansas and Mississippi; Ocala National

Forest in Central Florida). Using all available resources, each group completes the following tasks through their research about their assigned site (written on the board for easier student access):

- Describe the terrain and common weather patterns of your site.
- Describe the conditions and resources that Florida panthers require for survival (shelter, water, food, and space).
- Describe the areas that border your site. Speculate about how changes in these adjacent areas may affect the future conditions of your site.
- Create a pie chart that illustrates what percentage of the site is privately owned and what percentage of the site is owned or protected by the local or federal government. Speculate about how these percentages may change in the future and the potential impact of such changes.
- Compare and contrast conditions of your site to the current conditions of the Big Cypress Swamp region.
- Based on your research, offer an evaluation of this site’s suitability for reintroducing a Florida panther population.

4. WRAP-UP/HOMEWORK: Based on the group research, each student creates an illustrated promotional brochure aimed at the Florida panther population, urging them to relocate to their group’s site. The brochures should emphasize, in a creative manner, the advantages of their site and downplay the disadvantages. Brochures should be presented and displayed in a future class.

#### **Further Questions for Discussion:**

- How did the Endangered Species Preservation Act (1966) and the Endangered Species Conservation Act (1969) enable the preservation of the Florida panther population?
- Why do you think the Florida panther was chosen as Florida’s official state animal and the mascot for their NHL hockey team?
- Why is inbreeding highly correlated with genetic defects?
- Why does the male Florida panthers’ range differ from the females’ range?
- What animal and plant life can be found in the Big Cypress Swamp ecosystem?
- What other types of ecosystems exist?

#### **Evaluation / Assessment:**

Students will be evaluated based on thoughtful participation in small group and class discussion, participation in their group research and site evaluation, and final promotional brochures.

#### **Vocabulary:**

vast, exuberance, subtle, redoubt, stealthy, peril, habitat, encompasses, palmettos, terrain, markedly, inbreeding, puma, susceptible, cryptorchid, malformed, restoration, hybrids, robust, blustery, festooned, bromeliads, lethal, saturation, predator

#### **Extension Activities:**

1. Research how inbreeding has affected many breeds of purebred dogs. After researching the harmful effects of such breeding practices, write an editorial on the subject for your school newspaper.

2. Research and chart the cougar subspecies in North America (of which the Florida panther is one). Include in the chart both the subspecies names and the common names for each entry in your chart. Then, create a hypothetical subspecies name and common name for the hybrid that has been created as a result of crossbreeding the Texas cougar and the Florida panther.
3. Why do the male Florida panther's range requirements (100-200 square miles) differ from the female Florida panther's range requirements (75-100 square miles)? After researching the answer to this question, write a humorous dialogue between a male and female Florida panther "couple" who is debating relocating from the Big Cypress Swamp region. The dialogue should highlight the different geographic and environmental needs of the male and female panthers.
4. Create a diorama of the Big Cypress Swamp region's ecosystem. Creatively display the region's terrain, vegetation and animal life (including mammals, reptiles/amphibians, invertebrates, and birds).

#### **Interdisciplinary Connections:**

Civics- Research the 1969 Endangered Species Conservation Act. Write a research paper about how the act was created and passed, and how it served as a turning point in the preservation of the Florida panther population.

Language Arts- Since the Florida National Hockey League team is named the "Florida Panthers," write a creative team cheer or song whose lyrics sing the praises of the Florida panthers who inspired the name choice.

Mathematics- Research statistics of the population of Florida panthers from 1967 (the year during which the federal government listed the Florida panther as "endangered") to the present year. Create a graph with one axis representing each year and the other axis representing population changes.

Media Studies- How have the panther and other species of "big cats" been used to promote the sale of many products, from cars to sportswear? Create a collage of images that illustrate this trend, and accompany the collage with an analysis of the marketing strategies that underlie such advertisements.

#### **Other Information on the Web:**

Florida Panther Net (<http://www.panther.state.fl.us/>) is a rich resource about the elusive, endangered Florida panther, its habitat, and the plants and animals that share its southwest Florida home.

The Florida Panther Society (<http://panthersociety.org/>) is a nonprofit environmental education and support organization for the Florida panther.

Bagheera- A Website for Endangered Species (<http://www.bagheera.com>) offers resources, databases, and specials about endangered and nearly-endangered species.

The U.S. Fish and Wildlife Service (<http://www.fws.gov>) aims to conserve, protect and enhance the nation's fish and wildlife and their habitats for the continuing benefit of people and species.

#### **Academic Content Standards:**

Grades 6-8

Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows ways in which species interact and depend on one another in an

ecosystem; Knows that all individuals of a species that occur together at a given place and time make up a population, and all populations living together and the physical factors with which they interact compose an ecosystem; Knows factors that affect the number and types of organisms an ecosystem can support; Knows relationships that exist among organisms in food chains and food webs

(CTSS – 'science', '6-8', '7')

Science Standard 9- Understands the basic concepts of the evolution of species. Benchmark:

Understands the concept of extinction and its importance in biological evolution

(CTSS – 'science', '6-8', '9')

Geography Standard 8- Understands the characteristics of ecosystems on Earth's surface. Benchmarks:

Understands the functions and dynamics of ecosystems; Understands ecosystems in terms of their characteristics and ability to withstand stress caused by physical events

(CTSS – 'social', '6-8', 'geo3')

Geography Standard 14- Understands how human actions modify the physical environment.

Benchmarks: Understands the environmental consequences of people changing the physical environment; Understands the environmental consequences of both the unintended and intended outcomes of major technological changes in human history

(CTSS – 'social', '6-8', 'geo5')

Geography Standard 18- Understands global development and environmental issues. Benchmarks:

Understands how the interaction between physical and human systems affects current conditions on Earth; Understands why different points of view exist regarding contemporary geographic issues

(CTSS – 'social', '6-8', 'geo6')

Grades 9-12

Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years; Knows ways in which humans can modify ecosystems and cause irreversible effects

(CTSS – 'science', '9-12', '7')

Science Standard 9- Understands the basic concepts of the evolution of species. Benchmark: Knows how natural selection and its evolutionary consequences provide a scientific explanation for the diversity and unity of past and present life forms on Earth

(CTSS – 'science', '9-12', '9')

Geography Standard 8- Understands the characteristics of ecosystems on Earth's surface. Benchmarks:

Understands how relationships between soil, climate, and plant and animal life affect the distribution of ecosystems; Knows ecosystems in terms of their biodiversity and productivity; Knows the effects of biological magnification in ecosystems; Knows the effects of both physical and human changes in ecosystems

(CTSS – 'social', '9-12', 'geo3')

Geography Standard 14- Understands how human actions modify the physical environment.

Benchmarks: Understands the role of humans in decreasing the diversity of flora and fauna in a region;



Understands the global impacts of human changes in the physical environment

(CTSS – ‘social’, ‘9-12’, ‘geo5’)

Geography Standard 18- Understands global development and environmental issues. Benchmarks:

Understands why policies should be designed to guide the use and management of Earth’s resources and to reflect multiple points of view; Understands contemporary issues in terms of Earth’s physical and human systems

(CTSS – ‘social’, ‘9-12’, ‘geo6’)

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## Florida Panther's Great Leap Hits a Wall

By MARK DERR



Tom and Pat Leeson/Photo Researchers

More panthers live in South Florida now than at any time in decades, an estimated 70 to 100 adults and kitten.

NAPLES, Fla. — The Big Cypress Swamp region of Southwest Florida is a vast, wet, mysterious land of biological exuberance and subtle beauty. It is, as well, the last redoubt of the Florida panther, the stealthy and powerful cat that roamed the southeastern United States until hunting and development isolated it here by the mid-20th century.

When they were first listed as endangered in 1967, barely 30 panthers were left. Biologists undertook a crash program to prevent them from vanishing completely, and today there are more panthers in South Florida — 70 to 100 adults and kittens — than at any time in decades.

Now the Florida panther faces a different peril, a product of the recovery program's success. Wildlife scientists caution that the current number of panthers may be as many as South Florida can hold.

Because at least 250 animals are needed for a self-sustaining population, the biologists say, new habitat must be found to support them. And the scientists warn that more must be done to secure the panther's South Florida habitat, 40 percent of which lies in private hands in two of the nation's fastest-

growing counties, Collier and Lee.

The Big Cypress Swamp encompasses two million acres, and it may be hard to believe that so vast an area can support only 100 or so panthers. But panthers need dry land with plenty of shrubs, palmettos and small trees, and that kind of terrain is scattered and in short supply.

Males have ranges of 100 to 200 square miles, females of 75 to 100, said Darrell Land, leader of the Florida Fish and Wildlife Conservation Commission's panther team. Yet people also want this land, and their interests seldom match the needs of panthers. Still, the panther's situation has improved markedly. A decade ago, it appeared doomed.

By the late 1980's, genetic tests and physical evidence showed that because of extensive inbreeding, the big cats — males can grow to 7 feet, tail to nose, and weigh as much as 140 pounds, females to 6 feet and 90 pounds — had entered a genetic bottleneck they could not escape.

Outward signs of "inbreeding depression" were kinked tails and cowlicks, recessive traits found in no other puma population. Heart defects were common, and the animals were increasingly susceptible to parasites and disease.

Most of the males were cryptorchid — with one or both testicles failing to descend — and had an extraordinarily high percentage of malformed sperm. The World Conservation Union warned that without human help, the Florida panther would probably be extinct by 2055.

In 1995, armed with evidence that Florida panthers and other North American pumas represented a single, unbroken population, with regular gene flow between them, biologists began a bold experiment: they imported eight female cougars from the West Texas hills to the South Florida swamps. Three of the Texas cats died before they could breed, but the others produced at least two litters each, and geneticists are calling the restoration a qualified success.

Only three of the five are left alive, and they are scheduled for removal to a wildlife preserve this winter, said Dr. John Kasbohm, the federal Fish and Wildlife Service biologist in charge of the federal recovery effort. But Mr. Land, of the state agency, says at least 40 of the 70 to 100 South Florida cats are hybrids of Texas cougars and Florida panthers.

The hybrids are robust, with no physical signs of inbreeding, biologists say. The hybrids also have no sperm or testicular problems common to pure Florida panthers, said Dr. Jo Gayle Howard, a reproductive physiologist at the National Zoo.

Dr. Stephen J. O'Brien, chief of the National Cancer Institute's genomic diversity laboratory, said the hybrids showed "more variation all along the genome, in keeping with what geneticists predicted."

Critics of the restoration, including Dr. David S. Maehr, a wildlife biologist at the University of Kentucky and former leader of the state's recovery program, argue that the crossbreeding has gone too far and that all hybrid males should be removed to prevent them from "swamping" or genetically overwhelming the Florida panther. But Dr. O'Brien said there was no genetic evidence that the Texas hybrids were swamping Florida panthers.

Dr. Robert C. Lacy, a population geneticist with the Chicago Zoological Society, who is involved in World Conservation Union studies, said the Texas cougars had probably contributed 20 percent to 30 percent of the genetic material now in the Florida panther population, slightly above the initial goal of the program, but not high enough to cause problems. That may change, he cautioned, with the projected introduction of Texas cougars every 5 to 10 years, to correct inbreeding defects that will arise again because the population remains so small and isolated.

On a three-hour panther monitoring flight out of Naples, a little past dawn on a blustery late September morning, René de Jong guided his single-engine plane eastward above the gated golf-course communities and subdivisions hopscotching their way inland from the gulf coast.

He flew low over cypress strands and domes festooned with bromeliads, hardwood hammocks laced with royal palms, pine flatwoods and wet and dry prairies that define the Big Cypress Swamp ecosystem. In the cabin, David Shindle, a state biologist, listened intently for the distinctive ping from a radio collar.

These three-times-a-week flights are intended to mark the locations of the 33 radio-collared panthers, to gain insight into their habits. But they also give biologists a clear view of the roads, quarries, citrus groves, farm fields and developments that are squeezing the panthers.

The state and the federal governments have bought enough land in panther country to reduce private holdings to 40 percent from 50 percent in the past decade, Mr. Land said. But it is now essential to redouble efforts to buy and restore critical habitat, he added, to regulate density and to work with landowners to accommodate the panthers.

Mr. Land said a rise in lethal fights and roadkills point to a population nearing saturation and looking for places to go. "We're hauling out more panthers with their heads crunched in as a result of territorial battles," he said.

Over the past five years, at least four males have crossed the Caloosahatchee River, running from Lake Okeechobee to the Gulf of Mexico and long assumed the natural northern boundary of their territory, Mr. Land said. At least two died. But in over three years, a cat designated Florida Panther 62 traveled north nearly to Walt Disney World, and east within 10 miles of Melbourne and Vero Beach on the Atlantic. His collar failed on July 24, 2000, when he was within 15 miles of the Caloosahatchee, and he vanished from view.

Dr. Maehr, the former leader of the recovery program, has recommended moving at least one female north of the Caloosahatchee so the population can expand.

Other cats are reproducing in areas they have not occupied for years, including the southern part of the Big Cypress National Preserve and Everglades National Park, said Roy McBride, who has used hounds to trap panthers for wildlife officials since 1981.

But Mr. Land and other biologists believe that those areas are marginal habitats. A natural disaster or collapse in the wild hog or deer populations — favored prey — could drive panthers away, he suggested, and depress the overall population.

Dr. Kasbohm, the federal biologist, is helping prepare a plan that will evaluate sites for new populations

of panthers in their historic range, from western Louisiana to Arkansas and South Carolina. Sites under study, he said, include the Apalachicola National Forest in the Florida Panhandle; the Osceola National Forest and Okefenokee Swamp in North Florida and South Georgia, national forests in Arkansas and Mississippi, and Ocala National Forest in Central Florida.

No one involved in the project believes that reintroducing a large predator any place will be easy, if it can succeed at all. Even with an additional population, Dr. Kasbohm said, it is not clear that the Florida panther will ever "get to recovery and be removed from the endangered species list."

But with a little help from their friends, the cats are fighting back.

## Talking 'Bout Regeneration

By **GEORGIA SCURLETIS and BRIDGET ANDERSON**

*Note: This lesson was originally published on an older version of The Learning Network; the link to the related Times article will take you to a page on the old site.*

Teaching ideas based on New York Times content.

**Overview of Lesson Plan:** In this lesson, students research the regenerative capabilities of certain organisms. They then present their findings at a “regeneration symposium” aimed at exploring the possibilities of human regeneration.

### Author(s):

Georgia Scurletis, The New York Times Learning Network

Bridget Anderson, The Bank Street College of Education in New York City

**Suggested Time Allowance:** 45 minutes- 1 hour

### Objectives:

Students will:

1. Speculate about the potential impact of human regeneration.
2. Learn about the current research in the field of regeneration by reading and discussing “Missing Limb? Salamander Just Grows It Back.”
3. Research certain organisms and their regenerative processes.
4. Synthesize their understanding of regeneration by creating illustrations and presentations to be shared at a “regeneration symposium.”

### Resources / Materials:

-student journals

-pens/pencils

-paper

-classroom blackboard

-copies of “Missing Limb? Salamander Just Grows It Back” (one per student) See link here:

[http://www.nytimes.com/learning/teachers/featured\\_articles/20020924tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20020924tuesday.html)

-five slips of paper or index cards, each containing the name of an organism that can regenerate (hydras, planaria, frogs, salamanders, zebrafish)

-resources for researching the regenerative capabilities of different organisms (science and biology textbooks; encyclopedias; books on regeneration; computers with Internet access)

### Activities / Procedures:

1. WARM-UP/DO NOW: Students respond to the following prompt, written on the board prior to class: “According to Merriam-Webster, to regenerate a body part is ‘to replace [it] by a new growth of tissue.’ How could human life change if regeneration of diseased or missing tissue were possible?” Have

students share their hypothetical scenarios of human regeneration. What organisms have the ability to regenerate? How are humans “biologically hindered” when it comes to regeneration compared to these organisms?

2. As a class, read and discuss “Missing Limb? Salamander Just Grows It Back,” focusing on the following questions:

- a. Why is one of the laboratories at the University of California at Irvine called the “Leg Lab”?
- b. According to the article, why are salamanders the “superstars of regeneration”?
- c. According to some scientists, why would natural regeneration be preferable to transplanting tissue created from stem cells?
- d. How did the company Hydra get its name?
- e. How is human regeneration severely limited?
- f. What is the story behind the one possible example of multi-tissue regeneration in humans?
- g. How does de-differentiation work?
- h. According to Dr. Tsilfidis, what is the relationship between evolution and an organism’s ability to regenerate?
- i. What are the theories that could explain why “higher animals” cannot regenerate lost body parts?
- j. According to Dr. Ellen Heber-Katz, why is it important that “healer mice” do not form scars?
- k. What 18th century discovery ignited a “frenzy of experimentation” in the field of regeneration?
- l. Why are zebrafish easier to study than salamanders?
- m. What steps in regeneration follow dedifferentiation?

3. Explain to students that today they will be preparing to make presentations on certain organisms that currently have the ability to regenerate body parts. Their audience will be scientists interested in furthering research in the field of natural regeneration of human tissue. Divide students into five groups, and have each group select a slip of paper or index card containing the name of an organism that has the capacity to regenerate (hydra, planaria, frogs, salamanders, zebrafish). (Teachers may want to substitute other regenerating organisms if they would better compliment their curriculum). Using all available resources, each group answers the following questions regarding their organism (written on the board for easier access):

- What body parts can this organism regenerate?
- Do the regenerated body parts differ in any way from the original body parts?
- Does this organism’s ability to regenerate change over time?
- What conditions are needed for this organism to regenerate?
- Does this organism use the process of de-differentiation to regenerate, or does it use some other process?
- Could the current research on this organism’s ability to regenerate have any implications for future research on human regeneration?

Before the class ends, group members should divide the organism’s regeneration process into distinct phases to be later illustrated for homework.

4. WRAP-UP/HOMEWORK: Each student creates an illustration of a phase of his or her group’s

organism's process of regeneration. In a later class, each group will present their illustrations and research on their organism's process of regeneration at a "regeneration symposium." While each group is presenting, the other class members should offer questions or comments about any implications they see for future research on regenerating human tissue.

**Further Questions for Discussion:**

- Why is more funding going to stem cell research than to research on natural regeneration?
- How could regenerative medicine dramatically change the field of medicine?
- How might the study of genetics solve the mystery of regeneration?
- How is age sometimes correlated to an organism's ability to regenerate?
- Why is stem cell research a politically charged topic?
- How and why do different countries inhibit or promote research in the fields of stem cell research and cloning?

**Evaluation / Assessment:**

Students will be evaluated based on their initial journal entries, thoughtful participation in class discussion, participation in their group research, and final illustrations and presentations.

**Vocabulary:**

retinas, amphibians, induce, feats, garnering, fathom, serpent, planarian, extracted, revert, primordial, blastema, proliferating, replenished, surmised, frenzy, decapitating, harnessed, intractable, correlate, manipulated, tantalizing, protruding, concede

**Extension Activities:**

1. Since he has been in office, President George W. Bush has decided to limit federal funding of stem cell research to certain "cell lines" that already exist. Research the moral, political, and scientific implications of Bush's decision and hold an in-class debate on the topic.
2. Visit the virtual "Leg Lab" at University of California at Irvine's Web site (<http://darwin.bio.uci.edu/~mrjc/regen.html>) to learn about the different stages of regeneration and to see a time-lapse movie of regeneration in the axolotl's front leg. After visiting the site, create a flip-book that simulates the regeneration of another organism's missing body part. Each page of the flip-book should show a slightly different stage of the regeneration so that when you flip the pages the regeneration appears to be happening before your eyes.
3. Visit the Odelberg Laboratory's Web site ([http://odelberglab.genetics.utah.edu/regen\\_history.htm](http://odelberglab.genetics.utah.edu/regen_history.htm)) to learn about the scientific history of regeneration research. Choose a scientist that performed an important role in this field and write a series of fictionalized diary entries from his perspective during his study of regeneration.
4. Research how doctors can reattach human body parts through microsurgery. How does microsurgery differ from other surgical procedures? Write an informative pamphlet on the topic geared toward patients who might be considering microsurgery.



**Interdisciplinary Connections:**

Fine Arts- Research the Greek myth of Hercules and his attempts to slay the Hydra, a monster with nine heads and the power to regenerate. Draw an image that captures the action of this myth in a single scene.

Global Studies- Research different nations' policies regarding stem cell research and cloning. Make a chart that summarizes these policies and the impact that they have had on the scientific community.

Language Arts -Read Madeleine L'Engle's "The Arm of the Starfish," a novel about a doctor who is studying the regenerative powers of starfish and makes a startling discovery. Rewrite a scene in this novel to incorporate more current research in the field of regeneration.

-Write a short science fiction story based on the concept of human regeneration. What might happen, for example, if humans suddenly became as "regeneratively able" as salamanders?

Technology- Research how advanced artificial legs can use transducers to send electrical signals to the user's stump, therefore enabling them to move in a more natural way. Create a "How it Works" poster to illustrate the robotic process.

**Other Information on the Web:**

The Regeneration Gap (<http://www.nature.com/nsu/011122/011122-14.html>) is an article from Nature.

Starting Over ([http://www.sciencenews.org/sn\\_arc97/11\\_1\\_97/bob1.htm](http://www.sciencenews.org/sn_arc97/11_1_97/bob1.htm)) is an article from Science News Online.

**Academic Content Standards:**

Grades 6-8

Science Standard 5- Understands the structure and function of cells and organisms. Benchmarks: Knows that all organisms are composed of cells, which are the fundamental units of life — most organisms are single cells, but other organisms are multicellular; Knows that cells convert energy obtained from food to carry on the many functions needed to sustain life; Knows the levels of organization in living systems, including cells, tissues, organs, organ systems, whole organisms, ecosystems, and the complementary nature of structure and function at each level; Knows that multicellular organisms have a variety of specialized cells, tissues, organs, and organ systems that perform specialized functions; Knows how an organism's ability to regulate its internal environment enables the organism to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment

(CTSS – 'science', '6-8', '5')

Science Standard 16- Understands the scientific enterprise. Benchmarks: Understands ethics associated with scientific study; Knows that throughout history, many scientific innovators have had difficulty breaking through accepted ideas of their time to reach conclusions that are now considered to be common knowledge; Knows ways in which science and society influence one another

(CTSS – 'science', '6-8', '16')

Grades 9-12

Science Standard 5- Understands the structure and function of cells and organisms. Benchmarks: Knows

the structures of different types of cell parts; Understands the chemical reactions involved in cell functions; Knows how cell functions are regulated through changes in the activity of the functions performed by proteins and through the selective expression of individual genes, and how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division; Understands the processes of cell division and differentiation; Knows the structures of proteins and the role of proteins in cell function

(CTSS – 'science', '9-12', '5')

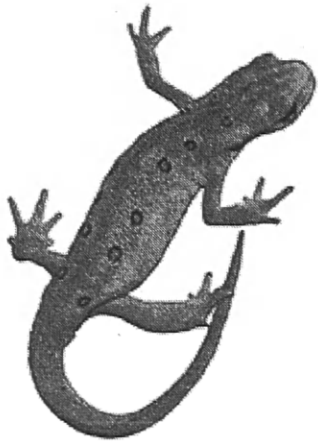
Science Standard 16- Understands the scientific enterprise. Benchmarks: Understands the ethical traditions associated with the scientific enterprise and that scientists who violate those traditions are censored by their peers; Knows that science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen; Knows that creativity, imagination, and a good knowledge base are all required in the work of science and engineering

(CTSS – 'science', '9-12', '16')

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## Missing Limb? Salamander May Have Answer

By ANDREW POLLACK



University of Illinois

The New York Times

IRVINE, Calif. — In a closetlike room at the "Leg Lab" here, salamanders stare blankly out of clear plastic drinking cups. The lab is so named because many of the animals have had, or will have, a leg cut off. But the salamanders recover, with perfect new limbs growing back in weeks.

Salamanders are the superstars of regeneration. They can grow back not only limbs but also tails, parts of their hearts and the retinas and lenses in their eyes. Humans cannot do any of that. So scientists here hope that the salamander's tricks may one day be applied to people.

"I really do believe it's just a matter of time before you're going to regenerate an arm or at least a finger," said Dr. David M. Gardiner, a biologist who runs the laboratory at the University of California at Irvine with Dr. Susan V. Bryant, the dean of biological sciences and his wife. "I'd like to see that in my lifetime."

Regenerative medicine, regrowing or repairing damaged organs, has become a hot topic. Almost all the attention has focused on stem cells. The idea is to grow stem cells outside the body, turn them into particular types of tissue and transplant them into patients.

But a few scientists theorize that a better approach is to induce the same regeneration in people that occurs in salamanders and some other animals. Natural regeneration, which might be accomplished with drugs or genes, would be easier than transplanting, they say. And the tissue would be the patient's own, doing away with the problem of rejection. Even if salamanders' feet cannot be reproduced in

humans, those scientists say, studying regenerating animals will at least provide clues for stem cell scientists.

So far, natural regeneration remains a medical backwater, garnering little attention. That may be understandable. Scientists have been studying natural regeneration for 200 years and have not gotten far in understanding it. Regrowing human arms in the lifetime of Dr. Gardiner, who is 53, will be difficult.

"I'd like to say we've made tremendous progress, but that would be a lie," said Dr. Catherine Tsilfidis, an assistant professor at the University of Ottawa Eye Institute, who is studying regeneration in newts.

Now, though, genetic techniques are starting to allow scientists to fathom the mechanisms of regeneration. That and the excitement surrounding regenerative medicine are creating new scientific and even commercial interest in regeneration.

Eli Lilly is supporting research aimed at finding genes that help amphibians regenerate, and venture capitalists recently invested \$9 million in starting what is perhaps the first company that wants to replicate natural regeneration in people.

The company, Hydra Biosciences, is largely based on the work of Dr. Mark T. Keating, a company founder and a biologist at Harvard who studies regeneration in zebrafish. Hydra of Cambridge, Mass., is named after a pond-dwelling creature that can grow two wholes after being sliced in two. That creature was in turn named for the mythical multiheaded serpent that regrew new heads when one was cut off.

"What we're trying to do is stimulate the body's natural ability to regenerate," Dr. Keating said. "There's no evidence that human cells are fundamentally different" from those of zebrafish.

Humans can regenerate some parts like livers, muscles and bones, but human regeneration is generally limited to single types of tissues. Salamanders can regrow multiple types of tissue to make complete structures like limbs. The planarian, a small flatworm, can be cut into pieces as small as one-279th of the whole, and entire new worms will grow from the segments.

The one possible example of multitissue regeneration in people is that young children can regrow fingertips above the top joint, including the bone, skin and nail. That was discovered by accident in England in 1974, when a child who lost a fingertip in a farm accident was taken to a hospital. The doctor was too busy to provide the standard treatment, sewing the skin closed. When she got around to it over a day later, she saw that it was regrowing.

Still, some experts say, that may not be true regeneration but rather a continuation of the fast growth that normally occurs in children's fingers.

Scientists say animals that regenerate do not do it the way scientists are now hoping to do it in people — by finding stem cells in the body that can be extracted or induced to turn into specific types of tissue. "The reason they can do this, we think, is not because they are chock-full of stem cells waiting to blast forth after an injury," said Prof. Jeremy Brockes of University College London.

Rather, he said, it appears that cells near the site of the injury that are already specialized like muscle cells lose their specialized properties and revert to a primordial state in a process called de-

differentiation. The animal, in effect, creates its own stem cells when they are needed.

Those stem cells form a mound called a blastema and multiply rapidly. They then redifferentiate to form the tissue needed to rebuild the limb or organ.

Scientists wonder why the ability to regenerate has not spread more widely through evolution. "It seems the higher up you move in terms of evolution," Dr. Tsilfidis said, "the less regenerative ability."

One reason, she speculated, is that higher animals depend more on specialized cells to perform sophisticated functions, and those cells are harder to de-differentiate. Or, she said, the advanced immune systems of higher life forms may mistake rapidly proliferating cells for cancer and kill them.

There are hints that this type of regeneration can occur in higher animals. Dr. Thomas A. Reh, a professor of biological structure at the University of Washington, found that neurons in a chicken retina could be replenished because other nerve cells called glial cells de-differentiated. In the distant future, Dr. Reh said, that may be used to help heal blindness caused by retinal diseases like macular degeneration.

Regeneration has been found in mammals, in a strain of mice with an altered immune system.

A few years ago, Dr. Ellen Heber-Katz, an immunologist at the Wistar Institute in Philadelphia, was conducting an experiment with those mice, which develop a disease similar to lupus. As is common, Dr. Heber-Katz punched a pattern of holes in each mouse's ear to so she could tell which mouse was which.

Three weeks later, she said, when she checked on the experiment, "there were no ear holes." Dr. Heber-Katz could not tell the mice apart. That ruined her experiment but sent her into a whole new field of study.

She has since found that those mice, unlike other mice, can also regrow parts of their hearts, tails and spinal cords. The fact that the "healer mice" do not form scars appears to be important, she said. Scars block the ability of cells to divide and block signals from the epidermis, a layer of skin, that appear necessary to begin regeneration, she said.

Scientists have been fascinated by regeneration since the 1700's, when a French scientist, René-Antoine Ferchault de Réaumur, for whom a temperature scale is named, noticed at the fish market that some crayfish had legs that were not the same size. He surmised that some legs had grown back after having been cut off. Other scientists around the same time found that hydra, snails and other creatures could regenerate, setting off a frenzy of experimentation.

"Almost everything that moved in Europe was amputated," said Dr. Alejandro Sánchez Alvarado, an associate professor of neurobiology and anatomy at the University of Utah. Even Voltaire decapitated a snail to see its head grow back. He then wrote to friend who was blind that he hoped that a similar process could be harnessed in people.

But that has proved difficult. Dr. Thomas Hunt Morgan studied regeneration at the beginning of the 20th century and basically declared the subject intractable. Dr. Morgan himself moved on to other areas, studying genes and chromosomes in the fruit fly, work that won him a Nobel Prize as the father of

modern genetics.

Now, scientists hope to understand regeneration by finding the genes involved. Dr. Heber-Katz has found at least seven locations on the chromosomes of her "healer mice" that appear to contain genes that correlate with the ability to regenerate.

Dr. Sánchez Alvarado is systematically turning off genes in planaria in hope of discovering which are necessary for regeneration. Dr. David Stocum, a biology professor and the dean of the School of Science at Indiana University-Purdue University Indianapolis, is studying which genes are active in tadpoles, which can regrow limbs, but not in adult frogs, which cannot.

One gene that appears to be important is *msx1*. It helps keep cells in an embryo from dividing prematurely. Dr. Keating found that when the gene was turned on in mouse muscle cells that were growing in culture, the cells de-differentiated into stem cells. Another tantalizing clue of the importance of *msx1*, Dr. Keating said, is that the gene is turned off in people, except in the fingertips, the one part of the body where regeneration has been seen.

Dr. Keating has also made mouse muscle cells de-differentiate by using an uncharacterized mixture of proteins extracted from a newt. Scientists at the Scripps Research Institute did that with a chemical called myoseverin.

The scientists focusing on natural regeneration concede that stem cell scientists are highly likely to make more progress in the near future.

"It's a lot easier to take a stem cell and put it back somewhere than to figure out what's going on here," Dr. Heber-Katz said.

But the salamander types insist that their time will come.

"Given that these mechanisms work so well in animals that are built like us," Dr. Brockes said, "it would really surprise me if there wasn't some role for this strategy in the future."

## **Domestic Bliss in Animal Husbandry?**

**By PRISCILLA CHAN and YASMIN CHIN EISENHAUER**

*Note: This lesson was originally published on an older version of The Learning Network; the link to the related Times article will take you to a page on the old site.*

Teaching ideas based on New York Times content.

**Overview of Lesson Plan:** In this lesson, students learn about a reindeer-based ethnic group in Mongolia. They then research other examples of animal husbandry and create models to represent the relationship between a particular population of animals and humans.

### **Author(s):**

Priscilla Chan, The New York Times Learning Network

Yasmin Chin Eisenhauer, Bank Street College of Education in New York

**Suggested Time Allowance:** 1 hour

### **Objectives:**

Students will:

1. Infer a meaning for the term “animal husbandry.”
2. Learn about one aspect of the practice by reading and discussing the article “Future of Ancient Culture Rides on Herd’s Little Hoofbeats.”
3. In groups, research a specific population of domesticated animal; create models emphasizing the animal-human relationship.
4. Individually, explain, using descriptions and facts, the animal-human relationship depicted in the models.

### **Resources / Materials:**

-student journals

-pens/pencils

-paper

-classroom blackboard

-copies of the article “Future of Ancient Culture Rides on Herd’s Little Hoofbeats,” available online at [http://www.nytimes.com/learning/teachers/featured\\_articles/20041221tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20041221tuesday.html) (one per student)

-handout of questions from Activity 3 below (one per group)

-resources about domesticated animal populations (computers with Internet access, almanacs, encyclopedias, library resources, etc.)

-arts and crafts materials (enough for class to share)

### **Activities / Procedures:**

1. WARM-UP/DO NOW: Upon entering class, students respond to the following prompt in their journals

(written on the board prior to class): "Have you even heard the term 'animal husbandry'? To what might it refer? Which of the following definitions do you feel are closest to the meaning of the phrase, and why? Support your guess.

- a. Animal husbandry is the study of adult males in a specific population of animals.
- b. Animal husbandry describes the strategies used by animals to find lifelong mates.
- c. Animal husbandry is the process by which animals are domesticated and maintained in healthy populations.

After a few minutes, allow students to share their responses. Discuss the context clues or multiple meanings of "husband" that might have led to a correct guess. As a class, discuss the actual meaning of the phrase (the correct answer is c). Ask students what populations of domestic animals in agriculture they know of (student responses may include cattle, goats, sheep, hogs and horses). Ask students, in the holiday spirit, if they feel that reindeer might be a domesticated population of animals, and how so.

2. As a class, read and discuss the article "Future of Ancient Culture Rides on Herd's Little Hoofbeats" ([http://www.nytimes.com/learning/teachers/featured\\_articles/20041221tuesday.html](http://www.nytimes.com/learning/teachers/featured_articles/20041221tuesday.html)), focusing on the following questions:

- a. Who are the Tsaatan? Where in the world are they located?
- b. What animal population resides with the Tsaatan?
- c. Who is Morgan Keay? What special tools did she bring for the Tsaatan?
- d. Why were these tools so special? What meaning did they have for the nomads?
- e. How do the reindeer allow the Tsaatan to subsist?
- f. What is the trend in the health of the reindeer population? Why is this alarming?
- g. What does the name "Tsaatan" mean?
- h. What strategy is Ms. Keay pursuing to improve the reindeer population numbers? What other population of reindeer will this involve?
- i. How will this strategy combat inbreeding?
- j. What is the goal and timeline of this project?
- k. Where are other herders of domestic reindeer located?
- l. From where is the legend of Santa Claus believed to have originated?
- m. What are possible causes of the decline in the Tsaatan reindeer population?
- n. What signs point to the prevalence of inbreeding in the population?
- o. How will they choose the "right" females for insemination?
- p. What challenges does the insemination project face? What other steps besides insemination are researchers pursuing, and why?
- q. What do other scientists say about the success of insemination, according to the article?
- r. Why is there no need to corral reindeer?

3. Divide the class into small groups of approximately three to four students. Explain to students that each group will be selecting a population of domesticated animals that have served a useful purpose for humans (such as cattle, goats, sheep, hogs, horses, silkworms, cobras, chickens, honey bees, ducks, carrier pigeons, turkeys, mealworms, alpacas, camels, donkeys, sled dogs, llamas, oxen, water buffalos,



yaks, pearl oysters, minks, fruit flies). Using available resources, each group will then be researching the answers to a set of guiding questions (photocopied on a separate handout for easier student access):

-What is the primary utility of this animal to humans (food, labor, transportation, research, commodity, etc.)? How is the animal utilized?

-Where in the world is this animal most commonly utilized?

-How did this animal become domesticated? Does this animal exist in the wild? In what capacity? Is it “captive-bred”?

-How is this population maintained and cared for?

-What challenges, if any, does this population face in maintaining its numbers and productivity? What strategies, if any, are being pursued to face these challenges?

As they complete their research, students should record the answers to these questions individually. Their notes will assist in the completion of their homework.

Each group must then, based on their answers, create a 3-dimensional animal and landscape model (or diorama), using available materials, that shows the following:

-the animal being utilized for its primary purpose for humans (such as plowing land, laying eggs, being shorn for fur, etc.)

-an example of animal husbandry (rest for pregnant females, separation of sick animals in an infirmary, testing candidates for successful artificial insemination, etc.)

-a geographic physical setting (a rice paddy, a dairy farm, a coop, etc.)

After the models or dioramas have been created, they should be displayed around the classroom. In a future class, each student should have the opportunity to view the models from other groups and provide feedback and constructive criticism. Then, as a class, discuss the commonalities and differences evident in the dioramas. What are similar characteristics of domesticated populations? How are some domesticated populations unique?

4. WRAP-UP/HOMEWORK: Students may take additional time, if necessary, to complete their portion of the group’s model or diorama. Additionally, students individually write a vivid description of their model, emphasizing the relationship between animals and humans being depicted. The descriptions should explain how each element of their model is inspired by their research. What facts from the group research support the representation that their group has chosen? These descriptions may be appended to the models around the classroom.

#### **Further Questions for Discussion:**

-What was the first domesticated animal?

-What is a “pet”?

-What is a “shepherd”?

-How does artificial insemination work?

#### **Evaluation / Assessment:**

Students will be evaluated based on initial journal responses, thoughtful participation in class

discussions, cooperation in small groups, creation of accurate models, and written explanations of their models.

**Vocabulary:**

nomadic, herders, steppe, subsistence, intimately, domesticated, supplements, diminished, decline, husbandry, insemination, combat, inbreeding, replenish, nucleus, originated, complex, mismanagement, predation, prevalence, reduced, teats, ominously, inbreeding, insemination, undernourished, conceive, rump, predation, diverse, vaccinating, graze, lichen, docile, corrals

**Extension Activities:**

1. Create a model of what you think the reindeer herd record-keeping books described in the article may look like. Then research other tools that are currently used in animal husbandry practices. What methods, equipment, monitors, technology or Internet-enabled software have made agriculture or animal breeding more productive or efficient? Develop a comparison chart between different tools.
2. The sustainability of the reindeer population is a function of many complex factors. Select an industry that is based on a domesticated population, such as cattle. Research and discuss the “complex factors” that affect this particular industry (such as market rates, eating habits of consumers, the emergence of disease, etc.) in a brief analysis paper.
3. Profile the Wildlife Conservation Society (<http://wcs.org/>). What does this organization do? Where in the world does it have programs? What activities does it operate through its Mongolia program? What is the mission of this organization?
4. Design a flow chart that describes the process by which food gets from the farm to your table. During which steps do regulatory interventions by the United States Department of Agriculture (U.S.D.A.) or other government agency come into play? How are public health interests considered and safeguarded throughout this process?
5. What is the mythology behind reindeer? Choose another animal that may have a similar history or mystique (such as polar bears, scorpions, anacondas, etc.) and compare the legends that surround these animal populations. Is there a link or characteristic that makes this animal more intriguing than other animals, and why? Write a children’s book about this animal.
6. Create a color-coded map of Mongolia that describes the different types of terrain and indigenous animal life found there: desert, steppe, taiga, etc.

**Interdisciplinary Connections:**

Language Arts – How many collective nouns do you know for groups of animals (such as a congregation of alligators or a cloud of bats, etc.)? Create a quiz for your friends. How many do they know? Where do these collective nouns originate?

Mathematics – Select ten countries and compare their rates of deforestation (data available from the Food and Agriculture Organization of the United Nations at [http://www.mongabay.com/deforestation\\_simple.htm](http://www.mongabay.com/deforestation_simple.htm)). Graph and calculate the total change in forestation in thousands of hectares for each country by manipulating the percentage change and total

land area. Show all of your calculations.

Teaching with The Times – Read and clip articles from the newspaper that describe animal populations. What are central themes about these animal articles? Do they refer to the animals' relationship and utility to human beings? Is there a concern implied about the conservation of animals due to negative environmental interactions with humans? Is there a new interest in a particular animal population, and why? Compare and contrast reasons why a topic related to animals is considered to be noteworthy. To order The New York Times for your classroom, click here.

**Other Information on the Web:**

"A Nomad Among Nomads in Mongolia" by Michael Benanav (<http://www.nytimes.com/2003/10/05/travel/a-nomad-among-nomads-in-mongolia.html?pagewanted=all&src=pm>) describes the writer's "250-mile solo trek" through a little-traveled mountainous region in Mongolia.

The Animal Disease Research Unit (<http://www.ars.usda.gov/Main/docs.htm?docid=3941>) describes basic research endeavors of the United States concerning persistent diseases of domestic animals. National Geographic provides another perspective on populations which rely on domesticated reindeer in the article "'Reindeer People' Resort to Eating Their Herds" ([http://news.nationalgeographic.com/news/2004/11/1104\\_041104\\_reindeer\\_people.html](http://news.nationalgeographic.com/news/2004/11/1104_041104_reindeer_people.html)).

**Academic Content Standards:**

Grades 6-8

Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows ways in which species interact and depend on one another in an ecosystem; Knows that all individuals of a species that occur together at a given place and time make up a population, and all populations living together and the physical factors with which they interact compose an ecosystem; Knows factors that affect the number and types of organisms an ecosystem can support; Knows relationships that exist among organisms in food chains and food webs

Geography Standard 8- Understands the characteristics of ecosystems on Earth's surface. Benchmarks: Understands the functions and dynamics of ecosystems; Understands ecosystems in terms of their characteristics and ability to withstand stress caused by physical events

Geography Standard 14- Understands how human actions modify the physical environment.

Benchmarks: Understands the environmental consequences of people changing the physical environment; Understands the environmental consequences of both the unintended and intended outcomes of major technological changes in human history

Geography Standard 18- Understands global development and environmental issues. Benchmarks:

Understands how the interaction between physical and human systems affects current conditions on Earth; Understands why different points of view exist regarding contemporary geographic issues

Language Arts Standard 1- Demonstrates competence in the general skills and strategies of the writing process. Benchmarks: Uses style and structure appropriate for specific audiences and purposes; Writes expository compositions; Writes compositions that speculate on problems/solutions

Language Arts Standard 4- Gathers and uses information for research purposes. Benchmarks: Uses a variety of resource materials to gather information for research topics; Determines the appropriateness of an information source for a research topic; Organizes information and ideas from multiple sources in systematic ways

Grades 9-12 Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years; Knows ways in which humans can modify ecosystems and cause irreversible effects

Geography Standard 8- Understands the characteristics of ecosystems on Earth's surface. Benchmarks: Understands how relationships between soil, climate, and plant and animal life affect the distribution of ecosystems; Knows ecosystems in terms of their biodiversity and productivity; Knows the effects of biological magnification in ecosystems; Knows the effects of both physical and human changes in ecosystems

Geography Standard 14- Understands how human actions modify the physical environment. Benchmarks: Understands the role of humans in decreasing the diversity of flora and fauna in a region; Understands the global impacts of human changes in the physical environment

Geography Standard 18- Understands global development and environmental issues. Benchmarks: Understands why policies should be designed to guide the use and management of Earth's resources and to reflect multiple points of view; Understands contemporary issues in terms of Earth's physical and human systems

Language Arts Standard 1- Demonstrates competence in the general skills and strategies of the writing process. Benchmarks: Writes compositions that are focused for different audiences; Writes compositions that fulfill different purposes; Writes expository compositions; Writes reflective compositions

Language Arts Standard 4- Gathers and uses information for research purposes. Benchmarks: Uses a variety of news sources to gather information for research topics; Synthesizes information from multiple research studies to draw conclusions that go beyond those found in any of the individual studies

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## Future of Ancient Culture Rides on Herd's Little Hoofbeats

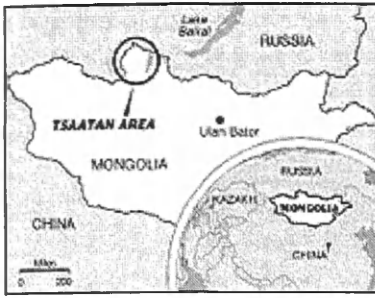
By AMANDA LEIGH HAAG



A domesticated reindeer in the Mongolian herd gets an injection after a checkup.



Morgan Keay, who has traveled to Mongolia to study animal husbandry, helped found a nonprofit foundation to combat inbreeding and replenish the reindeer herd there.



The New York Times

BOULDER, Colo., Dec. 20 - When Morgan Keay visited the tiny nomadic group of reindeer herders known as the Tsaatan in Mongolia in August, she asked what she could bring them on her return. Their request was simple, she recalls. "We really need herd record-keeping books," they told her. "We want them to be waterproof" and to fit in a pocket. "They should come with a pencil," the herders went on, "because pencil doesn't bleed when it gets wet. And they should all be in Mongolian."

So when Ms. Keay and other researchers crossed the Mongolian steppe on horseback in the bitter cold in October and headed north to the subarctic forest known as the taiga, they carried three dozen herd management logbooks, one for each of the families, in waterproof binders. Seeing the herders' faces as the books were handed out, she said later, "was just one of those moments that are worth a million bucks."

Aside from their practical purpose, the books are a symbol of hope for the Tsaatan, of the Dukha ethnic group. Their subsistence culture, which is at least 3,000 years old, is intimately tied to the domesticated reindeer - for dairy products; for their velvety antlers, used in diet supplements; and for riding to fresh grazing grounds.

But the health of the herds has diminished sharply over the last several years. Reindeer numbers have dropped 40 percent in less than 10 years, to about 600 from 1,000. A continued decline would threaten the culture of the Tsaatan, whose very name means "with reindeer."

When Ms. Keay, a 23-year-old biology graduate of the University of Colorado, went to Mongolia in 2002 to study animal husbandry, the herders approached her about using artificial insemination to combat inbreeding and replenish the herd. So she helped found a nonprofit foundation, called Itgel for the Mongolian word for hope. Next year a team from the foundation plans to begin its first round of insemination, using sperm from Canadian reindeer.

Dr. Jerry Haigh, a professor at the Western College of Veterinary Medicine in Saskatchewan who is the team's lead veterinarian, says the goal is to create a nucleus of healthy reindeer within three or four years.

The Tsaatan are not the world's only herders of domestic reindeer. There are others in Russia, China, Alaska and northern Europe, including the Saami, from which the legend of Santa Claus and his reindeer may have originated. But Ms. Keay says her team will be the first to use artificial insemination to restore a herd. Their aim is to protect not just the reindeer but an ancient culture that depends on them.

A number of complex factors are to blame for the decline of the Tsaatan herd, including mismanagement during Communist occupation of the country, predation by wolves and a host of rare diseases. Researchers are finding a high prevalence of brucellosis, a bacterial disease that leads to joint swelling and reproductive abnormalities, infecting as much as 25 percent of the herd.

Among the reindeer that remain, calves are being born smaller and weaker, and more females are having twins, which rarely survive. The herders have also found females with reduced numbers of teats, and there is a trend toward more white pelts in the herd - all signs that point ominously to inbreeding.

Choosing the right females for insemination will involve a scoring system for measuring fat content and overall health. They will be ranked on a five-point scale, from undernourished to too fat; females ranked 3 store body fat at the right time of year and are most likely to conceive. "Jerry taught the herders how to do it," said Ms. Keay. "He had all the herders out feeling the rump of their reindeer, saying, 'Look for 3's, look for 3's.' "

Getting reindeer semen from North America to the taiga has its challenges. It must be kept frozen in a vault of liquid nitrogen and carried by horseback over the Mongolian steppe, then by reindeer. Some wildlife biologists have raised doubts about insemination, saying that more genetic analysis is needed to determine whether the Tsaatan herd is actually inbred, and that other factors, like predation by wolves, need to be addressed.

"Unless efforts are put into improving the wildlife populations and calf survival, all the A.I. in the world is still going to result in a decline in the population," said Kirk Olson, a biologist with the Wildlife Conservation Society's Mongolia program. "Wolves and people will simply be eating more genetically diverse deer."

Ms. Keay says her team is using other approaches as well, including vaccinating reindeer for brucellosis and giving the herders veterinary training. But genetic testing to determine the degree of inbreeding is years from completion, she said; by then, the reindeer could all be gone, along with the Tsaatan culture.

For now, daily life goes on for the Tsaatan. They wake around 6 a.m., and women begin milking the female reindeer. After milking, they release them to graze on lichen. The reindeer are docile, so there is no need for corrals. Reindeer often come when called, and some have names, like Bagabognoo - Mongolian for "small loved one." As for Ms. Keay, she says that when she returns to the taiga next August, she looks forward to finding the reindeer record books all filled in.

# Datasets for Animal Tracking

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**Grade Levels:** Elementary and Middle School

**Length of Lesson Sequence:** 60 Minutes

**Brief Description:**

Numerous datasets are available on the internet and are free to use, but many educators are unaware of these opportunities and how to incorporate firsthand research into lessons. Satellite telemetry data from individual organism tracking experiments has been valuable to conservation scientists, but can also be used as an educational tool in elementary science classrooms. Elementary school teachers will be led through an activity in which they find online datasets from individual animal tracking observations and use them to create paper and digital maps of the individual's travels. Participants will also be shown how to use the internet to calculate the distance an animal traveled. Elementary school teachers can use this knowledge in their own classrooms to create exciting maps and lessons for their students, or to teach upper elementary students how to use the websites themselves to explore the fascinating biology that can only be studied through satellite telemetry.

**Content Statements/Standards Covered:**

Benchmarks noted for Michigan Elementary Science

I.1.E.1 - Generate questions about the world, based on observation.

I.1.E.5 - Develop strategies and skills for information gathering and problem solving.

II.1.E.1 - Develop an awareness of the need for evidence in making decisions scientifically.



III.4.E.2 - Explain how physical and behavioral characteristics of organisms help them to survive in their environments.

### **Prerequisite Knowledge:**

Before beginning this lesson, students are expected to be able to

- read a map (figure out which direction is north, tell the difference between land and water, etc.)
- find locations on a map by latitude and longitude coordinates

### **Objectives of Lesson:**

At the conclusion of the lesson, students will be able to

- find online datasets from observations that have tracked individual animals
- calculate the distance traveled by individual animals
- make a map of where the animal traveled
- explain why scientists track animals

## **Materials and Resources**

- Computers with a spreadsheet program and internet access for every 2 participants
- Digital projector and projector screen
- Maps of North America or of the ocean with latitude/longitude lines for each participant

### **Definition (from [www.dictionary.com](http://www.dictionary.com))**

- Telemetry - the science and technology of automatic measurement and transmission of data using radio or satellite signals from remote sources to receiving stations for recording and analysis

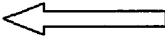
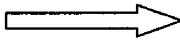
### **Strategy**

- **Learning cycles:** learning useful knowledge by participating in practices (model, coach,

fade)

*Observations, patterns, and explanations*

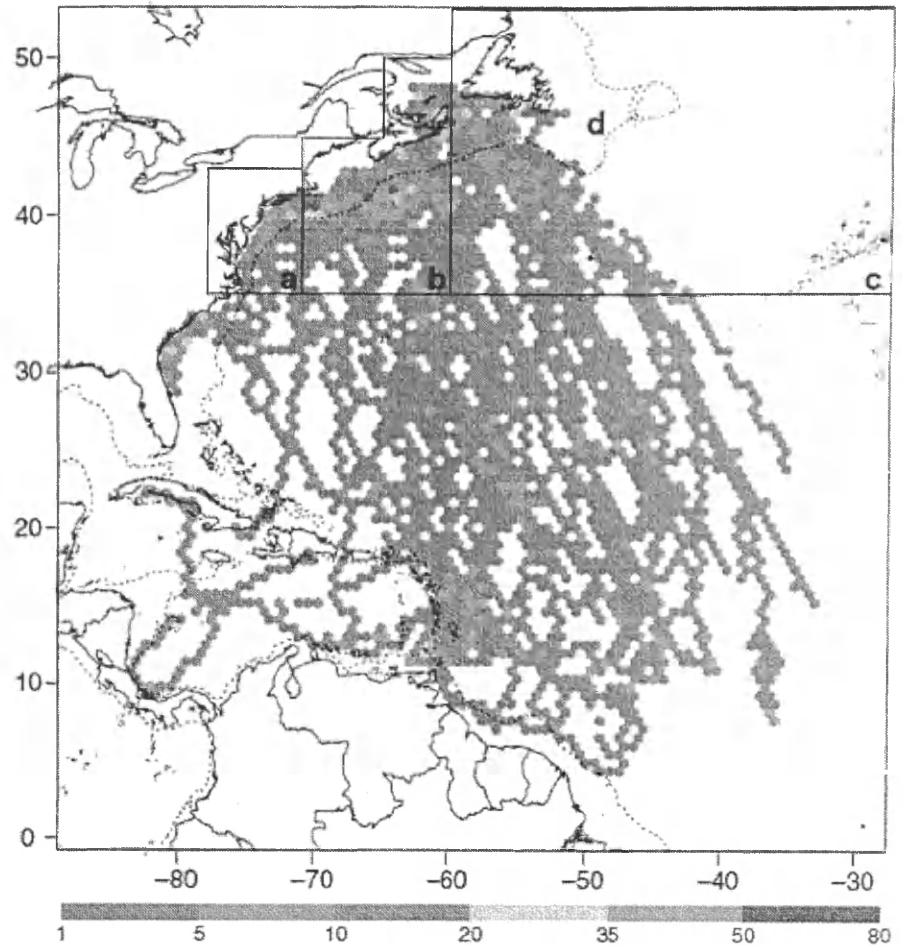
***In the chart below, describe the connected observations, patterns, and explanations or models that you will use for your session.***

<b>Observations or experiences (examples, phenomena, data)</b>	<b>Patterns (laws, generalizations, graphs, tables, categories)</b>	<b>Explanations (models, theories)</b>
Online datasets listing data collected for individual animal tracking observations	Maps made which show where the animals traveled Graphs showing the distance traveled per unit time	Correlations made between an animal's movement / home range and environmental conditions / trophic status
 <b>Application: Model-based Reasoning</b>		
<b>Inquiry: Finding and Explaining Patterns in Experience</b> 		

## Introduction/Anticipatory Set

A story will be shared about a scientific study (James et al. 2005) that was initiated to use individual organism telemetry data in attempt to learn more about how to approach conservation of critically endangered Atlantic leatherback sea turtles. Accidental capture and death during fishing operations threaten the status of these long-lived organisms. Previous knowledge of the species' habitat was collected through fishermen observations and small-area behavioral studies, which caused conservation efforts to be focused on a very small portion of the species' habitat. By using telemetry to track individual organisms for up to a year as they move, scientists found that turtles spent much more time at northern latitudes than had been previously realized, and were experiencing high rates of accidental death (Figure 1). The scientists were able to conclude that fishing practices need to be adjusted, because excluding fishing from small areas will only displace it to other areas where they pose just as much of a risk to the turtles. Conservation actions must be expanded to larger areas of the marine habitat in order to save the species from eventual extinction.

**Figure 1** Spatial use by 38 leatherback turtles equipped with Argos satellite tags in waters off Nova Scotia, Canada. Colour denotes the number of days turtle(s) were observed in each hexagon (width:  $0.719^\circ$  longitude, largest height:  $0.709^\circ$  latitude). US pelagic longline reporting areas: (a) Mid-Atlantic Bight, (b) Northeast Coastal and (c) Northeast Distant. Area (c) extends eastward to  $-20^\circ$  longitude and northward to  $55^\circ$  latitude, and was closed to US pelagic longline vessels to protect marine turtles. Area (d), Grand Banks. Dashed line: 1000 m depth contour.



## Activities of the Session

- Introduction activity as stated above will include pictures and graphs from the study to display on a screen to stress the importance of tracking animals for conservation purposes
- Tracking animals can also be a great way to learn more of the basic biology of certain organisms, and are fun and easy to learn at the elementary school age
- Class participants will work in groups of two or three and will be asked to make sure their own computers are on
- Participants will do the activity as outlined in the Animal Tracking Datasets Exercise

## Conclusion

- Students will be asked to share how they might use organism tracking datasets in their own classrooms, and it will be opened for a short discussion.
- Students should be informed any additional information about tracking animals, including potential costs listed on the websites:
  - <http://www.npwrc.usgs.gov/resource/wildlife/radiotrk/globpos.htm>
  - <http://www.spacetoday.org/Satellites/Tracking/SatTracking.html>

## Assessment

Students may be assessed on their ability to make a map and calculate distance traveled using a dataset with latitude and longitude of an individual species. They may also be assessed on their ability to make predictions about animals whose movements they haven't mapped yet.

## Modifications and Accommodations (Optional)

- Students will work in groups of two or three, so those that do not feel comfortable working on the computer can observe another student.
- If computers are not available, the teacher can find the data on one computer and have the students map it on sheets of paper.
- For younger grades, the teacher can make the map and the students can interpret the movements of the animal.

## Extensions (Optional)

- Students can make correlations between an animal's travels and the environment
- Students can make conclusions about home ranges of animals in different trophic levels and different thermo-regulation mechanisms.
- Students can map other animals' movements using datasets found on the other websites listed at the end of this lesson plan.

## Literature Cited

James, M.C., C.A. Ottensmeyer, and R.A. Myers. 2005. Identification of high-use habitat and threats to leatherback sea turtles in northern waters: new directions for conservation. *Ecology Letters* 8: 195-201.

## Blank Maps

- For other datasets, the teacher can make a blank map using the website [http://www.planiglobe.com/omc\\_set.html](http://www.planiglobe.com/omc_set.html)
- Find the farthest extent that the animal traveled in each direction and enter those degrees of latitude and longitude into the form
- To make a black and white map suitable for printing out, select the “b/w map” option
- If you have certain features on the map, such as cities, that you want to name and you know their latitude and longitude, you can also plot those
- After you create the map, right click on it, copy it, and paste it into Word to print

## Internet Resources

### Space for Species

<http://www.spaceforspecies.ca/>

Latitude and longitude data, blank maps, weather, and habitat maps for a leatherback turtle, eider, caribou, polar bear, and peregrine falcon. Also has an educator’s zone for teaching ideas.

### Ocean Ambassadors

[http://www.oneocean.org/ambassadors/track\\_a\\_turtle/results/turtle\\_profiles.html](http://www.oneocean.org/ambassadors/track_a_turtle/results/turtle_profiles.html)

Latitude and longitude data and blank maps for several turtles near the Philippines. Really cool interactive maps! Also interpretations of why the turtles journeyed where they did and tons of information about turtles and why and how scientists track them.

### Whale Net

<http://whale.wheelock.edu/Welcome.html>

Latitude and longitude data, maps, blank maps, and background information about several dozen dolphins, porpoises, seals, and sea turtles

### Animal Planet’s DIY Animal Spies

<http://animal.discovery.com/convergence/spyonthewild/diyspies/diyspies.html>

Instructions for how to track marine animals using Whale Net, how to track migrating birds, and some links to websites with blank maps

#### Alaska SeaLife Center

[http://www.alaskasealife.org/master/animal\\_tracking/index.html](http://www.alaskasealife.org/master/animal_tracking/index.html)

Latitude and longitude data, maps, background information, and videos for five rehabilitated seals

#### International Wolf Center

[http://www.wolf.org/wolves/experience/telemsearch/vtelem/telem\\_intro.asp](http://www.wolf.org/wolves/experience/telemsearch/vtelem/telem_intro.asp)

Township, range number, section number, and background information for several dozen wolves in Superior National Forest, but need a map they sell to plot the locations

#### The College Science Classroom

[http://www.nsta.org/main/news/stories/college\\_science.php?news\\_story\\_ID=52254](http://www.nsta.org/main/news/stories/college_science.php?news_story_ID=52254)

How to use data and maps from the International Wolf Center in a college setting

#### Meet the Swans

<http://www.bsc-eoc.org/lpbo/swans/eachswan.html>

Maps of individual swan migration routes

#### Tagging of Pacific Pelagics

[http://las.pfeg.noaa.gov/TOPP\\_recent/index.html](http://las.pfeg.noaa.gov/TOPP_recent/index.html)

Maps of sharks, cetaceans, seals, sea turtles, and birds. Can click on big map (or on tables below) to get maps of individual animals' journeys displayed over maps of sea temperature, chlorophyll-a, and currents. Can also do a day-by-day progression through all the records of animals of any particular species.

#### Santa Cruz Predatory Bird Research Group

<http://www2.ucsc.edu/scpbrg/migration.htm>

Maps of individual bald eagle migration routes

Ressources Naturelles et Faune Quebec

<http://www.mrnf.gouv.qc.ca/english/wildlife/maps-caribou/maps.jsp>

Weekly maps of caribou herd locations 2005-2006

Space Today

<http://www.spacetoday.org/Satellites/Tracking/SatTracking.html>

Talks about why scientists track animals, different ways to track animals, and some case studies of what scientists have learned from different groups of animals

USGS – Northern Prairie Wildlife Research Center

<http://www.npwrc.usgs.gov/resource/wildlife/radiotrkglobpos.htm>

A critique of wildlife radio tracking and its use in national parks



# Frogsicles

## How frogs survive the winter

Emily Grman ([grmanemi@msu.edu](mailto:grmanemi@msu.edu)), Sara Syswerda ([parrsar1@msu.edu](mailto:parrsar1@msu.edu))

### OVERVIEW

How do frogs survive the winter when they're frozen solid? Their heart may even cease to be beating, and yet they still bounce back just in time for springtime. You will complete three short lab experiments to explore topics that help explain how frogs freeze over the winter: solute concentration, osmosis, and freezing point depression.

### OBJECTIVES

At the conclusion of the lesson, students will be able to:

- Define and explain osmosis
- Predict the relative freezing points of pure water, salt water, and sugar water
- Understand that frogs have adaptations that help them survive the winter

### LENGTH OF LESSON

One and a half hours total will be required

### GRADE LEVELS

For high school science classes, but could be simplified for middle school and upper elementary.

### STANDARDS COVERED

from Science v.12.07 Grade Level Content Expectations

P.PM.01.21 Demonstrate that water as a solid keeps its own shape (ice).

P.PM.01.22 Demonstrate that water as a liquid takes on the shape of various containers

E.ES.01.22 Describe and compare weather related to the four seasons in terms of temperature, cloud cover, precipitation, and wind

E.FE.02.14 Describe the properties (hard, visible, freezing, ice) of water as a solid (ice, snow, iceberg, sleet, hail)



- L.OL.03.32 Identify and compare structures in animals used for controlling body temperature, support, movement, food-getting, and protection (for example: fur, wings, teeth, claws)
- L.EV.03.12 Relate characteristics and functions of observable body parts to the ability of animals to live in their environment (for example: sharp teeth, claws, color, body covers)
- P.PM.04.23 Compare and contrast the states (solids, liquids, gases) of matter
- L.EV.05.11 Explain how behavioral characteristics (adaptation, instinct, learning, habit) of animals help them to survive in their environment
- L.EV.05.12 Describe the physical characteristics (traits) of organisms that help them survive in their environment
- P.CM.06.11 Describe and illustrate changes in state, in terms of the arrangement and relative motion of the atoms or molecules

From High School Science Content Expectations (10/06)

- B2.3A Describe how cells function in a narrow range of physical conditions, such as temperature and pH (acidity), to perform life functions
- B2.3B Describe how the maintenance of a relatively stable internal environment is required for the continuation of life
- B2.3C Explain how stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents
- C3.3B Describe melting on a molecular level.
- C4.4a Explain why at room temperature different compounds can exist in different phases.
- C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution.

## **MATERIALS**

Lots of paper/plastic drinking cups (9 per group)

Tap water

1 M salt water solution (58 g NaCl/L or 225 g/gallon water), 1 quart per group

1 M sugar water solution (342 g sucrose/L or 1325 g sucrose/gallon water), 1 quart per group

Chipped or shaved ice, or ice cubes

Thermometers (1 per group)

Slices of potato

Slices of beet

Access to

([http://highered.mcgrawhill.com/sites/0072495855/student\\_view0/chapter2/animation\\_\\_how\\_osmosis\\_works.html](http://highered.mcgrawhill.com/sites/0072495855/student_view0/chapter2/animation__how_osmosis_works.html)) for osmosis video

## BACKGROUND

DavidsonLee98Color.pdf is a great reference—it explains everything teachers need to know (link at end of lesson plan). **Osmosis** is the diffusion of a solvent (frequently water) through a semi-permeable membrane, from a solution of low solute concentration (high water potential) to a solution with high solute concentration (low water potential), up a solute concentration gradient. **Freezing-point depression** describes the phenomenon that the freezing point of a liquid (a solvent) is depressed when another compound is added, meaning that a solution has a lower freezing point than a pure solvent.

## ACTIVITIES OF THE SESSION

1. Introduce the question: How do frogs survive the winter? Ask the students what they already know about frogs. Are they warm-blooded or cold-blooded? Can they heat their own bodies? What kinds of adaptations do other animals have for surviving winter (fur, feathers, fat, hibernation)? Do frogs have these?
2. Show the 4 minute video at <http://www.pbs.org/wgbh/nova/sciencenow/3209/05.html>
3. So how do frogs survive the winter? How can they freeze solid and then come back to life? Students may remember “antifreeze” and “sugar” from the video. How can these things help a frog?
4. Activity #1: What happens to slice of potato in tap water, sugar water, and salt water?

- a. Step one of answering our question, “How do frogs survive the winter” is to see what happens to cells in different solutions. This is the osmosis demonstration—but don’t tell the kids that’s what they’re doing.
  - b. Give each student or group of students three cups.
  - c. Label the cups with the type of liquid: one cup gets tap water, another gets saltwater, and the third gets sugar water.
  - d. Have the students put a slice of potato in each cup.
  - e. Add the liquids to the cups, enough to completely submerge the potato.
  - f. Put these cups aside and wait at least 30 minutes to see what happens.
5. Activity #2: How can sugar be an antifreeze? Solute concentration and freezing point depression.
- a. Bring out beakers/cups of ice water, ice sugar water, ice salt water.
  - b. Have the students measure the temperature of the water and fill out the datasheet in their student handouts.
  - c. Bring out beakers from the freezer containing pure water, sugar water, or salt water. Have students record whether “frozen solid” or the temperature of the liquid.
  - d. Discuss: does adding sugar lower the freezing point of water?
6. Finish Activity #1: Ask the students to make observations about their potato slices.
- a. Were they more floppy or stiffer than they started?
  - b. Why did this happen? (Osmosis caused water to go into potato cells in the tap water to balance the concentration of solutes. Osmosis caused water inside potato cells to go out, to try to balance the concentration of solutes in the salt and sugar water.)
  - c. Watch video  
([http://highered.mcgrawhill.com/sites/0072495855/student\\_view0/chapter2/animation\\_\\_how\\_osmosis\\_works.html](http://highered.mcgrawhill.com/sites/0072495855/student_view0/chapter2/animation__how_osmosis_works.html))
  - d. Diagram this on the board, have the students diagram it too.
  - e. Point out that floppy cells are unhappy cells. If the insides of cells lose too much water, they can suffer from dehydration and die.
7. Develop our hypothesis. How would changing the concentration of sugar help a frog survive the winter?
- a. Continue your diagram from the osmosis diagram. It has become a rough diagram of the cells of the heart—just enough to know that there are two regions: “inside the cell” and “outside the cell”
  - b. As it gets colder, ice crystals form on the outside of the cell. This causes the concentration of solutes outside the cell to increase. Draw this in the cell diagram—ice crystals form out of only water molecules, pushing molecules of other things to the side. This increases the concentration of solutes outside the cell.
  - c. Is this OK? What happens when the concentration of solutes inside the cell is much lower than the concentration outside (as it is now, as ice is forming outside the cell)? Students should recognize that osmosis causes water to leave the cell.

- d. But remember, dehydrated cells are unhappy cells. Frozen cells are also unhappy cells.
  - e. Where does the frog put the sugar? How does this help prevent its cells from freezing or from becoming too dehydrated? Add this to the diagram.
8. Activity #3: Testing our hypothesis. Set up the experiment one day, freeze experiment overnight, thaw before class so samples are liquid again for data collection.
- a. Have students label 3 cups with their names and the solution type (tap water, salt water, sugar water).
  - b. Put a slice of beet in each cup and put in the freezer.
  - c. Collect data on the color of the solution.
  - d. Discuss: How would the red color get out of the cells (cells burst and die)?
  - e. Which solution protected the cells from freezing?
  - f. Does this support our hypothesis?
9. Concluding discussion
- a. To review: frogs increase the concentration of sugars inside their cells to prevent cells from freezing (freezing point depression) and to prevent cells from getting too dehydrated.
  - b. How does the frog thaw in the spring?
    - i. Draw a rough diagram of a frog on the board and locate the heart and lungs
    - ii. Freezing point depression in internal organs means that these thaw before extremities.
  - c. If time allows: Why would a frog want to do this? Are there other ways to spend the winter? Why is overwintering as an adult the best idea? (What kind of activity immediately follows the spring thaw?)
  - d. Bonus: Salt seems to work better than sugar in these experiments. Why don't frogs use salt instead of sugar?

## RESOURCES

<http://www.sciam.com/article.cfm?id=how-do-frogs-survive-wint>

<http://www.pbs.org/wgbh/nova/sciencenow/3209/05.html>

[http://www.youtube.com/watch?v=Fjr3A\\_kfspM](http://www.youtube.com/watch?v=Fjr3A_kfspM)

[http://highered.mcgrawhill.com/sites/0072495855/student\\_view0/chapter2/animation\\_\\_how\\_osmosis\\_works.html](http://highered.mcgrawhill.com/sites/0072495855/student_view0/chapter2/animation__how_osmosis_works.html)

<http://www.units.muohio.edu/cryolab/publications/documents/DavidsonLee98Color.pdf>

## Frogsicle Student Worksheet

Your name: \_\_\_\_\_

Your group members' names: \_\_\_\_\_

### Problem:

After watching the video, make a **hypothesis** (an educated guess about the answer to the question):

### Activity #1: What happens to slices of potato in tap water, sugar water, and salt water?

#### Procedure:

1. Label one cup "Tap water," another cup "Salt water," and a third cup "Sugar water"
2. Put a slice of potato in each cup
3. Add these solutions to the cups. Use enough to completely cover the slice of potato.
4. Set the cups aside and wait at least 30 minutes.
5. After 30 minutes, record your observations. What happened to each slice?
  - a. Potato slice in tap water
  - b. Potato slice in salt water
  - c. Potato slice in sugar water
  - d. Potato in no solution
6. Draw a diagram that explains your results. Draw the cup, a potato cell, and the concentration of solutes inside and outside of the potato cells. Draw an arrow to explain which way water is moving in each cup. Which potato cells are the happiest? Which are the most dehydrated?

Tap water

Salt water

Sugar water

7. What is osmosis?

**Activity #2: How can sugar be an antifreeze?**

At what temperature does water turn into a solid (freeze)?

Do all liquids turn into solids at the same temperature?

Give examples of substances that turn solid at much higher (warmer) temperatures.

Can you think of any examples of substances that freeze at much lower (colder) temperatures?

Procedure:

1. Part 1: Ice

- a. Label three cups: one tap water, one sugar water, and one salt water.
- b. Fill the cups half full with the appropriate solution.
- c. Add shaved ice to the cups
- d. Measure the temperature of the cups, starting immediately and at each five minutes afterwards. Fill out the table below.

Time	Tap water	Sugar water	Salt water
Start			
5 minutes after start			
10 minutes after start			

2. Part 2: Samples from the freezer

- a. Your teacher will provide you with prepared samples from the freezer. Your job is to measure their temperature in the data table below. If the solution is solid and you can't put the thermometer in it, record "solid."

	Tap water	Sugar water	Salt water
Temperature =			

3. What did we find out? Can sugar act as an antifreeze?

**Activity #3: Testing our hypothesis**

How do we think frogs can survive the winter? Draw a diagram and explain in words.

Procedure:

1. Label 3 cups as in previous activities and include your name.
2. Fill the cups with the appropriate solution.
3. Put a slice of beet in each cup. Be sure the liquid covers the beet.
4. Put the cups in the freezer or outside overnight.
5. When you came back after your experiment was frozen and thawed, what had happened? Collect data on the color of the solutions in the table below.

	Tap water	Sugar water	Salt water
Color =			

6. What made the solution turn red?

7. Which cells were best protected against freezing?

8. Does this support our hypothesis?

9. How does the frog thaw in the spring?

# FROG LAB DISSECTION

Frogs belong to the class Amphibia. Amphibians have adaptations for living in terrestrial as well as aquatic environments. Frogs are among the most commonly studied organisms in Biology. Although many differences exist between humans and frogs, the basic body plans are similar. Humans and frogs both belong to the phylum Chordates. By studying the anatomy of the frog, you will be better able to understand your own body.

In this investigation, you will examine the external features of a frog and identify parts of its external anatomy. In addition, you will dissect a preserved frog to observe its internal anatomy.

## Problem

How is a frog structured for survival?

## Materials

preserved frog	dissecting tray	scissors
probe	forceps	hand lens
zip lock bag	dissecting pins	dissecting needle
paper towel	pipette	

## Clean up

- 1.) Wrap your preserved frog in a very moist piece of paper towel (prevents it from drying out) and place it in the zip lock baggie provided to you by your teacher.
- 2.) Be sure to use a sharpie to put your name and hour on the bag.
- 3.) Thoroughly wash (with soap and water) and dry your dissecting tray and tools.
- 4.) Wash your hands thoroughly with soap and water.
- 4.) Make sure everything at your lab station is put in the proper place and clean.
- 5.) Once your teacher has checked your lab station you may sit down.

## Procedure

### Part A: Technique of Animal Dissection

- 1.) Dissection is the technique of exposing the internal structures of an organism for observation. Dissection is commonly used in the study of large and complex plants and animals. The opportunity to dissect an animal should be thought of as a unique opportunity to gain firsthand knowledge of an animal you know little about. As you dissect, **you should think in terms of structure related to function.**
- 2.) Obtain the following tools and instruments: dissecting tray, scissors, probe, dissecting pins and forceps.

**CAUTION:** The scissors and probe are sharp. Use extreme care and caution when handling these instruments to avoid cuts. Always cut in a direction away from your hands and body.

- 3.) Read the following rules for dissection:
  - \* Before beginning a dissection, identify all external parts.
  - \* Determine the proper order in which internal structures are to be exposed (read the lab carefully).
  - \* Identify which structures could easily be damaged if dissection is not done properly.
  - \* Do not completely remove any body part unless instructed to do so.
  - \* When making the first cut, insert the point of the scissors just below the skin. Cut with short, clipping motions. Keep the lower blade of the scissors pointing upward away from the internal structures of the animal being dissected.



## Part B: External Anatomy of the Frog

- 1.) Obtain a preserved frog. Rinse with water to remove excess preservative. **CAUTION:** The preservative used on the frog can irritate your skin. Avoid touching your eyes while working with the frog. Dry the frog with paper towel and place it on the dissecting tray.
- 2.) Identify the **dorsal and ventral surfaces** as well as the **anterior and posterior ends**.  
**Answer questions 1 – 3.**
- 3.) Locate the **forelegs**. Each foreleg, or arm, is divided into 4 regions: upper arm, forearm, wrist and hand. Identify the parts of the forelegs.
- 4.) Locate the **hind legs**. Each hind leg is also divided into 4 regions: thigh, lower leg, ankle and foot. Identify the parts of the hind legs. **Answer questions 4 – 7.**
- 5.) Examine the hands and feet of the frog. If the hands have enlarged thumbs, then it is a male. **Answer question 8.**
- 6.) Locate the two large, protruding eyes. Lift the outer eyelid using a probe. Beneath the outer lid is an inner lid called the **nictitating membrane**. **Answer questions 9 and 10.**
- 7.) Posterior to each eye is a circular region of tightly stretched skin. This region is the tympanic membrane, or eardrum. Locate the tympanic membranes on both sides of the head. **Answer question 11.**
- 8.) Anterior to the eyes, locate two openings called the **external nares or nostrils**. **Answer questions 12 – 15.**
- 9.) On the diagram labeled **External Anatomy of the Frog** label the following areas and structures of the frog's external anatomy: **anterior, posterior, dorsal, ventral, forelimb, hand, hind limb, foot, tympanic membrane, nares, eye, nictitating membrane, mouth.**
- 10.) Hold the frog firmly in the dissecting tray. Using scissors make a cut at each hinged point of the jaw, as shown in Figure 1 (make sure you completely cut through the hinged jaw). **Caution:** To avoid injury, cut in a direction away from your hands and body.
- 11.) Open the mouth as much as possible. Under running water rinse away any excess preservative.
- 12.) The **tongue** is the most noticeable structure in the mouth. Observe where the tongue is attached and note the two projections at the free end. **Answer questions 16 – 18.**
- 13.) At the back of the mouth, locate the large horizontal opening, the **gullet** opening.
- 14.) In front of the gullet opening, find a vertical slit, the **glottis**. **Answer question 19.**
- 15.) Look for two openings on the back sides of the floor of the mouth. These are the openings to the vocal sacs. They are present in male frogs only.
- 16.) Examine the roof of the mouth. Run your fingers along the top jaw. The teeth you feel are the **maxillary teeth**.
- 17.) Near the front center of the mouth are two small bumps. These bumps are the **vomerine teeth**.
- 18.) On either side of the vomerine teeth are the openings to the **internal nares**.
- 19.) Behind the vomerine teeth, observe two large bulges. These bulges are the **eye sockets**.
- 20.) The openings of the **Eustachian tubes** are on either side near the back of the mouth. Insert a probe into an opening of one Eustachian tube. Note where the probe stops.  
**Answer questions 20 and 21.**
- 21.) On the diagram labeled **Mouthparts of the Frog** label the following structures: **vomerine teeth, maxillary teeth, internal nares, eye sockets, Eustachian tubes, tongue, gullet, glottis, vocal sacs.**

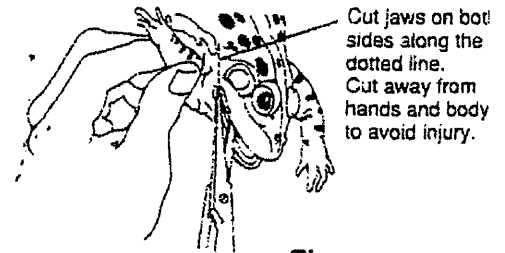
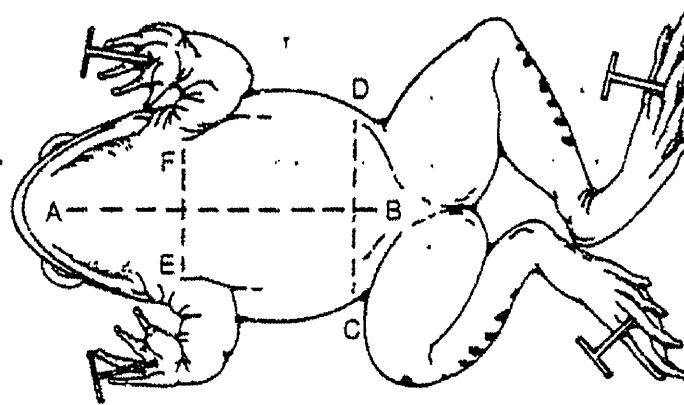


Figure 1

### Part C: Internal Anatomy of the Frog

- 1.) Place your preserved frog on the dissecting tray ventral side up. With dissecting pins, securely pin the frog's hands and feet to the bottom of the dissecting tray as shown in Figure 2.
- 2.) Angle the pins away from the body of the frog so that they will not interfere with our dissection.

Figure 2



- 2.) With forceps, lift the loose skin of the abdomen. Carefully insert the tip of a pair of scissors beneath the skin. (**CAUTION:** To avoid injury, cut in a direction away from your hands and body.) Cut the skin along line AB as shown in Figure 2. Using forceps continue cutting the skin along lines CD and EF. You may cut the skin as far back toward the dorsal surface to prevent it from being in your way.
- 3.) With your fingers, carefully separate the skin from the underlying muscles. Open the flaps of skin as far back as possible and cut them off.
- 4.) Notice the blood vessels branching throughout the inner lining of the skin. Observe the abdominal (frog pack) and pectoral muscles. Note the direction of the muscle fibers.

#### Answer question 22.

- 5.) Carefully lift the abdominal muscles with the forceps. Cut a second AB incision. **NOTE:** Keep the cut through the muscles shallow so as not to damage the underlying organs.
- 6.) As the incision is made in the chest, or pectoral area, you will need to cut through bone. This bone is part of the pectoral girdle. **NOTE:** Use extra force with the scissors when cutting through the bone. Be careful not to damage any of the internal organs below the bone. Make cuts CD and DE through the abdominal muscle. Cut the muscle as far back as possible.
- 7.) Once you have cut through the pectoral girdle (bone), use your 2 thumbs and pry it open. This will enable you to see the organs lying beneath the pectoral girdle. Use the dissecting pins in the hands to pin through the bone at an angle away from the body to give you a better view of the organs. **NOTE:** If you need help with this please ask your teacher.
- 8.) Study the positions of the exposed organs. Notice that most of the organs are held in place by thin, transparent tissues called **mesenteries**.
- 9.) If the frog is a mature female, the most obvious organs will be the ovaries. The ovaries are white sacs swollen with tiny black-and-white eggs. (If your frog is a male, find a female frog to view the ovaries). **Answer question 23.**
- 10.) If your frog has ovaries, carefully lift the ovaries from the body cavity, cut the attachments with scissors and remove the ovaries from the frog. **NOTE:** Be careful not to rupture the ovaries with the scissors. If the ovaries are ruptured, they can spill out a mess of eggs.
- 11.) Observe the reddish brown (may be light tan due to the preservative) organ in the upper part of the abdominal cavity. It is the **liver**. **Answer question 24.**

- 12.) With your fingers or probe, lift and separate the lobes of the liver upward. Behind the middle lobe, look for a greenish, finger-shaped gland. This gland is the **gallbladder**. You may be able to locate the bile duct leading from the liver to the gallbladder.

## DIGESTIVE SYSTEM

- 1.) Locate the **esophagus**, which is a white tube leading from the mouth to and connecting to the upper part of the white, muscular stomach. Notice the shape of the **stomach**.
- 2.) With scissors, cut open the stomach along the outside curve. Open the stomach and examine its structure and contents. **Answer questions 25 – 27.**
- 3.) Look for a constriction at the lowest part of the stomach. This constriction is the **pylorus**. The pylorus leads into a long, coiled **small intestine**.
- 4.) Pull the loops of the small intestine away from the body. Notice the **mesentery** that holds the intestines in place. **Answer question 28.**
- 5.) Inside the first loop of the small intestine near the stomach, locate a thin, white organ called the **pancreas**.
- 6.) Also in the intestinal mesentery, locate a brown bean-shaped organ called the **spleen**. **NOTE:** the spleen is an organ of the circulatory system.
- 7.) The small intestine ends in a large bag-shaped organ, the **large intestine**. The last organ of the digestive system is the **cloaca**, a passageway of urine and reproductive secretions. Undigested food leaves the frog's body through an opening called the **anus**. **Answer questions 29 and 30.**
- 8.) On the diagram labeled **Digestive System and other related organs of the Frog** label the following structures: **esophagus, stomach, pylorus, small intestine, large intestine, cloaca, liver, gallbladder, pancreas, mesentery, anus, spleen.**

## UROGENITAL SYSTEM

The reproductive system and urinary system of the frog are closely connected and can be studied as the combined Urogenital System.

- 1.) The two **kidneys** are reddish-brown organs located on the dorsal posterior wall of the abdominal cavity. The kidneys lie on either side of the backbone. **NOTE:** The kidneys may be covered with a thin membrane.
- 2.) The yellow, fingerlike lobes attached to the kidneys are **fat bodies**. A small, twisted tube called the **ureter** leads from each kidney into the sac-like **urinary bladder**. The bladder is connected to the **cloaca**.
- 3.) Locate the reproductive organs of the frog. If your frog is male, it possesses **testes**, tiny white or yellow oval organs found on the ventral surface of the kidneys. (If your frog is a female, locate a male frog to view the testes).
- 4.) If your frog is female, it possessed egg-filled ovaries that were removed earlier. If your frog is an immature female, the pale oval ovaries are located ventral to the kidneys. Leading from each ovary is a long coiled tube called the **oviduct**. The oviduct extends along the side of the body cavity. The oviduct eventually joins the cloaca.
- 5.) On the diagram labeled **Urogenital System of the Frog** label the following structures: **kidney, fat body, ureter, urinary bladder, cloaca, testes, ovary filled with eggs, oviduct.** **NOTE: You must label both diagrams.**

## RESPIRATORY SYSTEM

- 1.) Locate the two **lungs**. They are small, spongy brown sacs that lie dorsal to the right and left of the heart. Look for the bronchial tubes that extend from the anterior part of the lungs and join with the trachea, or windpipe.

- 2.) Insert a pipette into the glottis of the frog. Pump air into the lungs and observe what happens. **Answer question 31.**

### **CIRCULATORY SYSTEM**

- 1.) Locate the heart. The heart is encased in a membranous sac called the **pericardium**.
- 2.) Note the vessels attached to the heart. The large artery on the ventral surface of the heart is the **coronary artery**.
- 3.) With a probe touch and compare the walls of the two atria and the ventricle. **Answer questions 32 - 33.**
- 4.) Observe the dorsal surface of the heart. Locate the thin-walled triangular sac called the **sinus venosus**. Locate the two veins leading from the top and the one vein leading from the bottom of the **sinus venosus**.
- 5.) On the diagram labeled **The Frog heart** label the following structures: **right atrium, left atrium, ventricle, coronary artery, sinus venosus.**

### **MUSCULAR SYSTEM**

- 1.) Remove the pins from the frog's hands and feet.
- 2.) Cut the skin completely around the upper thigh of one leg, as if cutting off the leg of a pair of pants. With forceps, carefully pull the skin downward to the foot exposing the thigh muscles, knee and the calf muscles.
- 3.) Move the lower leg up and down to simulate the leg movement during a jump. Observe the various leg muscles involved in the leg movement. **Answer questions 34 and 35.**

NAME \_\_\_\_\_

## FROG LAB

### Lab Questions

Answer the following questions from your Frog Lab Dissection. Answers should be in complete sentences where necessary.

1.) Describe the color of the dorsal and ventral surfaces of the frog.

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2.) How is the coloration of the frog an adaptation to its habitat?

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3.) Is the skin of a frog smooth or rough? Moist or dry?

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4.) a.) Are the hind legs or forelegs more important in jumping?

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b.) Are the hind legs or forelegs more important in landing?

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5.) How does a frog use its forelegs and hind legs while swimming?

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6.) How many digits are on each of the frog's hands?

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7.) How many digits are on each of the frog's feet?

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8.) Is your frog a male or female? Explain.

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9.) Where is the nictitating membrane attached?

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10.) What purpose does the nictitating membrane serve?

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11.) What is the purpose of the tympanic membrane? Why is it flat?

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12.) How is the location of the nares an adaptation to living in water?

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13.) Describe the position of the frog when it floats.

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14.) What parts of the body remain above the surface of the water when the frog floats?

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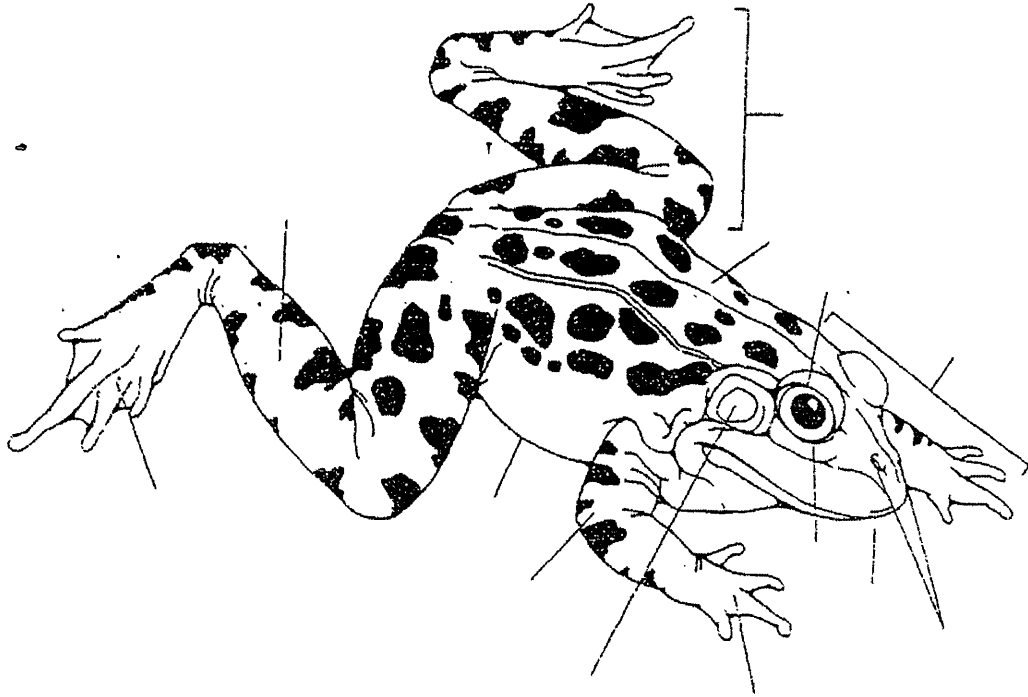
15.) The frog's sense organs are located on top of the head. How does this help the frog when it is in the water?

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**FROG  
EXTERNAL  
ANATOMY**



16.) Where is the tongue attached to the mouth?

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17.) What purpose do the projections at the end of the tongue serve?

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18.) The tip of the tongue in a live frog is sticky. What would be the advantage of this?

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19.) a.) Where does the gullet opening lead to?

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b.) Where does the glottis opening lead to?

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20.) Where does the probe stop after inserting it into the Eustachian tubes?

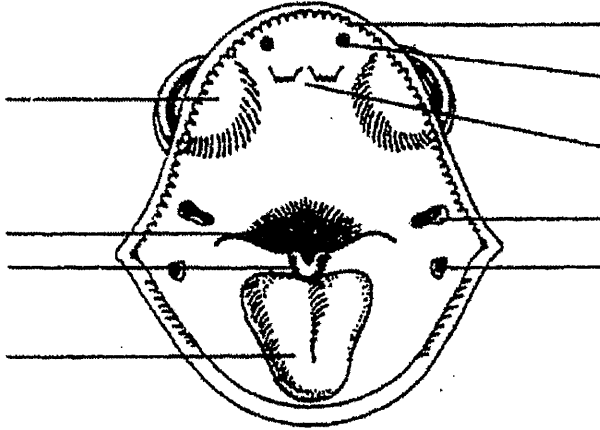
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21.) What purpose do the Eustachian tubes serve for the frog? \_\_\_\_\_

**FROG MOUTH PARTS**



22.) What was the direction of the muscle fibers?

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23.) Based on whether or not your frog had ovaries; does this agree or disagree with what you answered to question 8? Explain.

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24.) How many lobes does the liver contain?

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25.) What is the shape of the stomach?

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26.) Describe the inside wall of the stomach. Why is it this way?

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27.) Describe the contents of the frog's stomach (if any).

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28.) Describes the mesentery that holds the intestine.

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29.) How does the length of the small intestine relate to its function in absorbing digested food?

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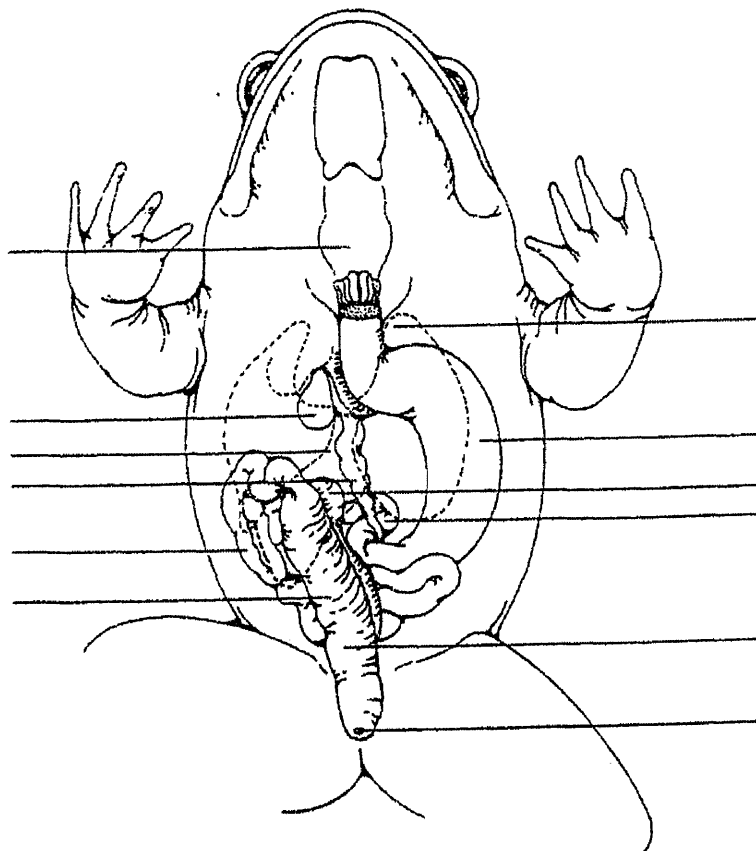
30.) Describe the general shape, or plan, of the frog's digestive system.

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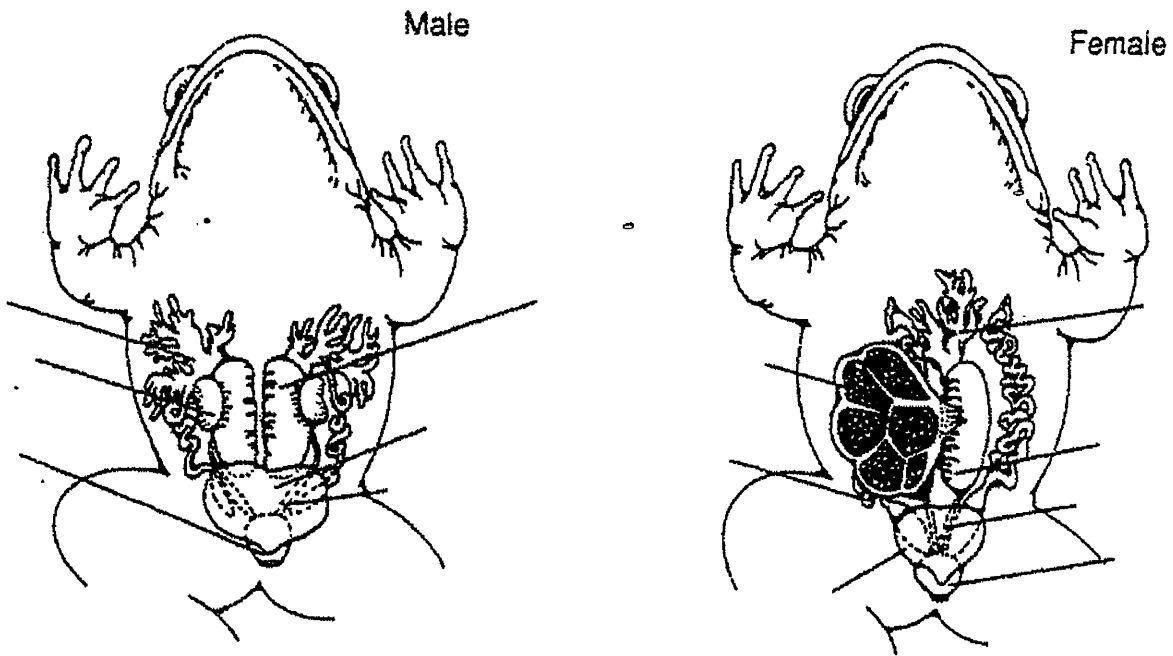
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**FROG DIGESTIVE SYSTEM AND OTHER RELATED ORGANS**



**UROGENITAL SYSTEM OF THE FROG (male and female)**



31.) What happens when air is pumped into the lungs?

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32.) What is the difference between the atrium and the ventricle? Why is one different? Explain.

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33.) Describe the pericardium. What function does it serve for the heart?

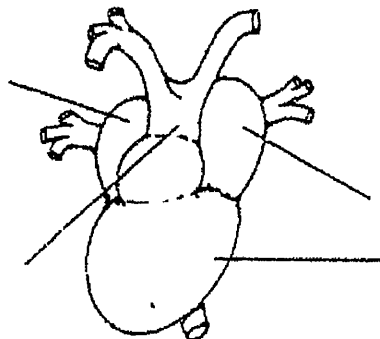
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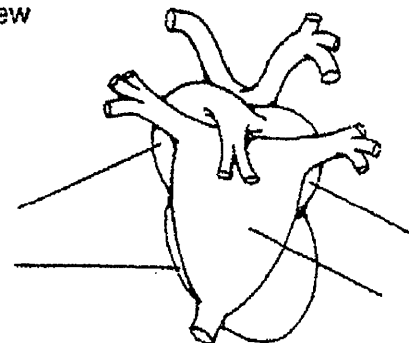
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**FROG HEART**

Ventral view



Dorsal view



34.) Describe the movement of the leg muscles as the leg is bent and straightened.

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35.) Describe how a frog jumps.

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36.) Describe three adaptations that permit a frog to live on land successfully:

- 1.) \_\_\_\_\_
- 2.) \_\_\_\_\_
- 3.) \_\_\_\_\_

37.) Describe three adaptations that permit a frog to live in water successfully:

- 1.) \_\_\_\_\_
- 2.) \_\_\_\_\_
- 3.) \_\_\_\_\_

**EXTRA CREDIT**

In the space below, in your own words give the function of the following organs:

**gall bladder**

**liver**

**pancreas**

**spleen**

**large intestine**

**small intestine**

**pylorus**

# **Frog Skin Comparison Lab**

## **Overview**

Students will understand how structure relates to function when viewing frog sperm, frog blood and frog skin.

## **Objectives**

1. Students will be able to write about how an objects structure relates to its function
2. Students will observe frog sperm, frog blood and frog skin to relate structure to function

## **Materials**

### **Introductory exercise materials**

Straw  
Brush  
Paperclip  
Tweezers  
Band aid  
Button  
Spoon  
Pencil  
Strainer  
Fork

Frog blood smear slide  
Frog Skin slide  
Frog sperm smear slide  
Microscope

## **Procedure**

### **Introductory exercise**

1. Students in groups of 2 or 3 will write a description of how a certain object's design helps it do its function/job
2. Students will record their description on their lab
3. Students will star their best description and share with the class

### **Microscope exercise**

1. Student will view the 3 prepared slides, sketch and color their observations and answer the questions that follow in the lab worksheet.

**Problem:** How does structure relate to function in cells?

One of the basic concepts of biology is that structure is related to function at many different levels of organization. In this investigation you will investigate this connection at the level of the cell. Cells are the basic unit of structure and function of all living things. It will be your job to relate function to structure in three types of typical animal cells.

**Objectives:**

1. Students will be able to write about how an objects structure relates to its function
2. Students will observe frog sperm, frog blood and frog skin to relate structure to function

**Introductory Exercise:**

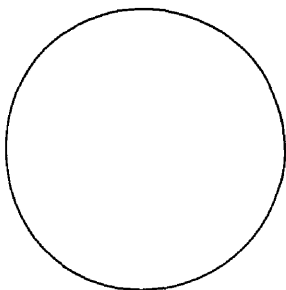
1. Using the objects provided, write a description of how a certain object’s design helps it do its function/job
2. Record your description in table 1
3. Star your best description and share with the class when asked by your teacher

**Table 1**

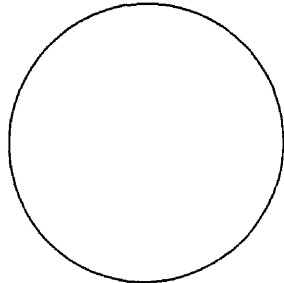
<b>Object</b>	Straw	Brush	Paper clip	Tweezers
<b>Description</b>				
<b>Object</b>	Band-Aid	Button	Spoon	Pencil
<b>Description</b>				

**Microscope exercise**

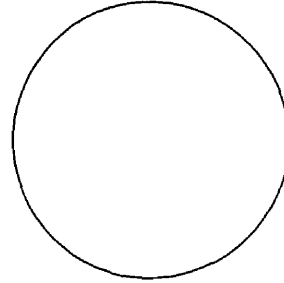
1. View the 3 prepared slides one by one
2. For each slide, sketch and color your observations under high power magnification (400x)
3. Answer the conclusion questions that follow



Frog Sperm (400x)



Frog Blood (400x)



Frog Skin (400x)

**Observations of Cell Structure and Function**

Name: \_\_\_\_\_ hr: \_\_\_\_\_

- 1. The main function of a cell is to maintain its own life processes. How does a nucleus allow a cell to accomplish this function?

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- 2. Compare the shapes of the three types of cells observed

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- 3. Which cell was best adapted for lining or covering? What characteristics let it serve this function well?

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- 4. Which cell was best adapted for carrying oxygen through the blood vessels? What characteristics let it serve this function well?

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- 5. Which cell was best adapted for traveling to another cell? What characteristics let it serve this function well?

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6. With sketch or in words, design a cell that would be adapted to take in nutrients from foods.

7. Look at a photograph of a muscle cell and a nerve cell. Relate their functions to their structures

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## **Amphibian Concept map**

### **Overview**

Students will synthesize information regarding Amphibians by using a concept map

### **Objectives**

1. Students will be able to organize information about Amphibians
2. Students will draw pictures, create cycles, create storyboards, etc., of their own design to describe Amphibians

### **Materials**

“What is an Amphibian?” Lecture  
Concept map slides printed 9 per page  
Scissors  
Markers/colored pencils or crayons  
Glue  
Easel paper or construction paper  
Rubric  
Textbook or internet access

### **Procedure**

1. Students will view the “What is an Amphibian Lecture”?
2. Students will cut out the Concept map PowerPoint slides
3. Students will organize the PowerPoint slides on the table with their group members in such a manner that the slides will help to create an overall poster that will include pictures (graphics), labels, facts etc. It may show a cycle or even tell a story (think comic book)!
4. Students will organize the PowerPoint slides onto their poster paper and glue them down.
5. Students will draw a picture surrounding the content facts.



## What is an Amphibian?

LET'S START WITH A VIDEO!

[CLICK HERE](#)

NATIONAL GEOGRAPHIC RED EYED TREE  
FROG

- Amphibian means 'two lived'
  - Life in water and life on land!
- Ectotherms
  - Use their environment to control their body temperature
- Moist skin
- Evolutionarily first vertebrates to venture onto land
- Varying reproductive strategies
  - Some lay eggs in water, some on land

## Representative Amphibians

- Frogs/Toads
- Salamanders/Newts
- Caecilians

Black-Chinned Red Salamander



Photo by Erin Harris

## Gray Cheeked Salamander



Photo by Erin Harris

Kingdom Animalia, Phylum Chordata, Class Amphibia

- There are currently 4450 extant species of Class Amphibia
- 390 are classified as salamanders
  - Order Caudata
- 4000 are frogs and toads
  - Order Anura
- 163 are caecilians
  - Order Gymnophiona

## Where do they live?

- Freshwater
- Moist terrestrial environments
  - live in the leaves, beneath stones, underground, beneath logs and in damp areas of trees
  - 44% of all Amphibians are found in the tropics

## Typical habitat for an Amphibian



Photo by Erin Harris

Can you see the Salamander hiding under tree bark?



Photo by Erin Harris

What do they eat?

- Amphibians are *the* primary vertebrate predators of invertebrates
- High biomass conversion
- Low energy use
  - lose less energy as heat
- Efficient in producing new tissue
  - Becomes available to predators
- Slow to mature and long lived
- Tiger Salamander video
  - [Click here](#)

## How do they reproduce?



- Viviparous-give birth to fully developed (metamorphosed) young
- Ovoviparous-carry eggs in oviducts or on parts of the body (mouth, stomach, skin pouches and sometimes vocal pouches)
- Oviparous-deposit eggs in aquatic areas where the hatch independently, mature into swimming larvae and then mature into terrestrial adults

## How do they get rid of waste?



- Amphibians filter wastes from the blood through their kidneys, and excrete either ammonia or urea as the waste product.
- Ammonia is excreted by amphibians that live in the water.
- Urea is stored in the urinary bladder until it is eliminated from the body through the **cloaca**.



- As larvae, most amphibians exchange gases through their skin and gills.
- As adults, most breathe through lungs, their thin, moist skin, and cavities in the mouth.



- Amphibians have a double-loop circulatory system.
- Amphibians have three-chambered hearts.

Moist skin

Webbed feet

Tympanic membrane

Vomerine teeth

Maxillary teeth

Nictitating membrane

aquatic

terrestrial

herbivore



carnivore

cloaca

Double loop circulatory system

Three-chambered hearts

Gas exchange

Partner Names:

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**Creating a Process Map**

Step ONE: Cut out the powerpoint slides

Step TWO: Organize them on the table with your group in such a manner that the slides will help to create an overall poster that will include pictures (graphics), labels, facts etc. It may show a cycle or even tell a story (think comic book)!

Step THREE: Organize these pieces onto your poster paper and glue them down.

Step FOUR: Draw your picture of the vertebrate surrounding your content facts/PowerPoint slides.

## Making A Poster : Process Mapping - Vertebrates

Teacher Name: \_\_\_\_\_

Student Name: \_\_\_\_\_

CATEGORY	4	3	2	1
<b>Required Elements</b>	The poster includes all required elements as well as additional information.	All required elements are included on the poster.	All but 1 of the required elements are included on the poster.	Several required elements were missing.
<b>Title</b>	Title can be read from 6 ft. away and is quite creative.	Title can be read from 6 ft. away and describes content well.	Title can be read from 4 ft. away and describes the content well.	The title is too small and/or does not describe the content of the poster well.
<b>Labels</b>	All items of importance on the poster are clearly labeled with labels that can be read from at least 3 ft. away.	Almost all items of importance on the poster are clearly labeled with labels that can be read from at least 3 ft. away.	Several items of importance on the poster are clearly labeled with labels that can be read from at least 3 ft. away.	Labels are too small to view OR no important items were labeled.
<b>Content - Accuracy</b>	At least 7 accurate facts are displayed on the poster.	5-6 accurate facts are displayed on the poster.	3-4 accurate facts are displayed on the poster.	Less than 3 accurate facts are displayed on the poster.
<b>Graphics - Originality</b>	Several of the graphics used on the poster reflect a exceptional degree of student creativity in their creation and/or display.	One or two of the graphics used on the poster reflect student creativity in their creation and/or display.	The graphics are made by the student, but are based on the designs or ideas of others.	No graphics made by the student are included.
<b>Knowledge Gained</b>	Student can accurately answer all questions related to facts in the poster and processes used to create the poster.	Student can accurately answer most questions related to facts in the poster and processes used to create the poster.	Student can accurately answer about 75% of questions related to facts in the poster and processes used to create the poster.	Student appears to have insufficient knowledge about the facts or processes used in the poster.

## **Reptile Concept map**

### **Overview**

Students will synthesize information regarding Reptiles by using a concept map

### **Objectives**

1. Students will be able to organize information about Reptiles
2. Students will draw pictures, create cycles, create storyboards etc. of their own design to describe Reptiles

### **Materials**

“What is a Reptile?” Lecture

Concept map slides printed 9 per page

Scissors

Markers/colored pencils or crayons

Glue

Easel paper or construction paper

Rubric

Textbook or internet access

### **Procedure**

1. Students will view the “What is a Reptile Lecture”?
2. Students will cut out the concept map PowerPoint slides
3. Students will organize them on the table with your group in such a manner that the slides will help to create an overall poster that will include pictures (graphics), labels, facts etc. It may show a cycle or even tell a story (think comic book)!
4. Students will organize the PowerPoint slides onto your poster paper and glue them down.
5. Students will draw a picture surrounding the content facts/PowerPoint slides.

## Representative Reptiles

# What is a Reptile?

LET'S START WITH A VIDEO!

[CLICK HERE](#)

THEN CLICK ON

→ ANIMALS

→ REPTILES

NATIONAL GEOGRAPHIC BLOOD SQUIRTING  
LIZARD

## Kingdom Animalia, Phylum Chordata, Class Reptilia

- Reptile means “to creep”
  - Laterally arranged limbs that create low ground movement
- Ectotherms
  - Use their environment to control their body temperature
- Dry skin
- Evolutionarily first terrestrial vertebrates
- Reproductive strategies
  - Lay shelled amniotic eggs

## Representative Reptiles

- Snakes and lizards
- Turtles and Tortoises
- Tuataras
- Alligators and Crocodiles

## Kingdom Animalia, Phylum Chordata, Class Reptilia

- There are currently 4 orders of Class Reptilia
  - Order Crocodylia (crocodiles and alligators)
  - Order Sphenodonta (tuataras)
  - Order Squamata (snakes and lizards)
  - Order Testudina (turtles and tortoises)

## Where do they live?

- They inhabit every continent except Antarctica

## How? What do they eat?

- Reptiles have several types of diets
  - Most are carnivores
    - Snakes can unhinge their jaws to swallow large prey items
    - Some lizards have long sticky tongues to catch insects
  - Iguanas and tortoises are herbivores
  - Some turtles are omnivores
    - Turtles and crocodiles have tongues to help swallow prey

## How do they reproduce?

- Reptiles use internal fertilization
- Reptiles produce leathery shelled amniotic egg
  - This egg has several internal membranes that house amniotic fluid.
    - Amniotic fluid mimics the aquatic environment of fish and amphibian embryos
    - The allantois sequesters waste
    - The chorion allows for oxygen to enter and keeps fluid inside the egg

## How do they get rid of waste?

- Reptiles filter wastes from the blood through their kidneys, and excrete uric acid as the waste product
  - Urine is reabsorbed to form a semi-solid secretion (uric acid)
- Waste is eliminated through the **cloaca**



## How do they breathe?

- Reptiles depend on lungs!
  - With larger lung surfaces, they can take in more oxygen and therefore more energy can be released through metabolic reactions!
    - This leads to more complex movements!

- Reptiles have a double-loop circulatory system.
- Reptiles have three-chambered hearts.
  - Crocodiles have a four chambered heart because of a septum that divides their ventricle
    - More efficient because oxygen-rich and oxygen poor blood does not mix!

Internal fertilization

Scaly dry skin

Shelled, Amniotic egg

terrestrial

Lungs for gas exchange

Three-chambered heart

Carnivore and herbivore

Vision is main sense

Jacobsen's organs

ectotherm

Clawed toes

**Partner Names:**

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**Creating a Process Map Rubric**

**Step ONE:** Cut out the powerpoint slides

**Step TWO:** Organize them on the table with your group in such a manner that the slides will help to create an overall poster that will include pictures (graphics), labels, facts etc. It may show a cycle or even tell a story (think comic book)!

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## Making A Poster : Process Mapping - Vertebrates

Teacher Name: \_\_\_\_\_

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## **Endangered Species Research Report**

### **Overview**

Students will organize information regarding a Reptile or Amphibian of their choosing.

### **Objectives**

1. Students will be able to organize information about Reptiles or Amphibians using the graphic organizer
2. Students will research using the internet or their textbook to create a summary of characteristics

### **Materials**

Rubric

Graphic Organizer

Textbook or internet access

### **Procedure**

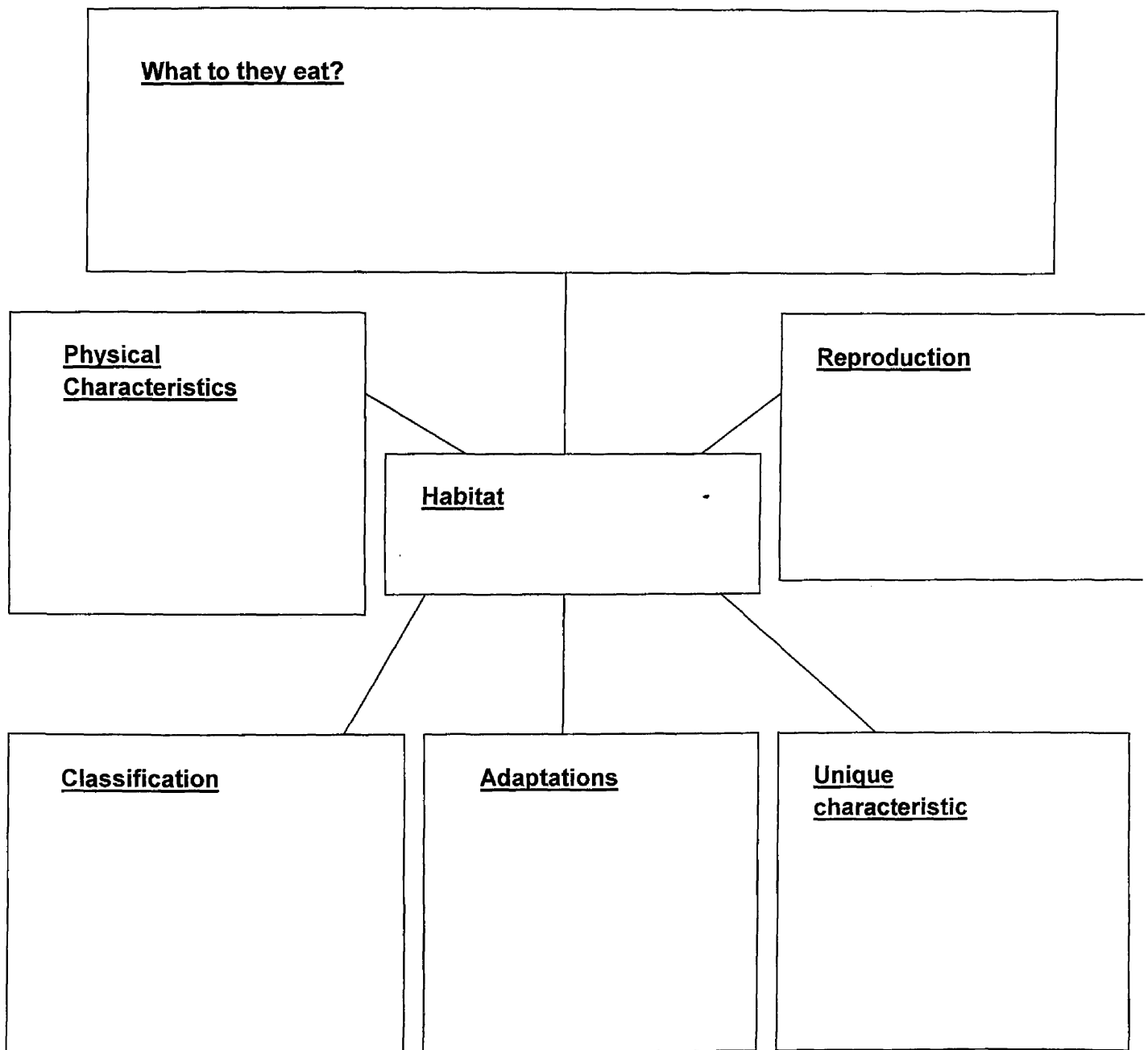
1. Students will choose an amphibian or reptile of their choosing to research.
2. Students will summarize information regarding general characteristics of their vertebrate

# Endangered Species Research Report

## OBJECTIVE:

For this exercise in research, you will utilize the internet and your Biology text in order to create a one page species report on your chosen vertebrate.

Use the following graphic organizer to record your research from the internet and/or your textbook.



Your graphic organizer must be turned in with your vertebrate species report.

**MANDATORY TOPICS OF DISCUSSION:**

- Where they live (and what kind of habitat),
- What they eat, (predator or prey? carnivorous, herbivorous, omnivorous)
- Physical Structure (scales? Tetrapod? Tail? Color?)
- Reproduction (viviparous, ovoviviparous, oviparous?)
- Adaptations (can they walk on water, lose their tail and still live?)
- Classification ( Kingdom, phylum, class, order, family, genus, species)
- Add in a characteristic that is unique to your vertebrate

\*paper should be written in 12 pt font of your own writing!! DO NOT PLAGARIZE!

## Research Report : Endangered Species Research Report

Teacher Name: \_\_\_\_\_

Student Name: \_\_\_\_\_

CATEGORY	4	3	2	1
<b>Organization</b>	Information is very organized with well-constructed paragraphs and subheadings.	Information is organized with well-constructed paragraphs.	Information is organized, but paragraphs are not well-constructed.	The information appears to be disorganized. 8)
<b>Quality of Information</b>	Information clearly relates to the main topic. It includes several supporting details and/or examples.	Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.	Information clearly relates to the main topic. No details and/or examples are given.	Information has little or nothing to do with the main topic.
<b>Paragraph Construction</b>	All paragraphs include introductory sentence, explanations or details, and concluding sentence.	Most paragraphs include introductory sentence, explanations or details, and concluding sentence.	Paragraphs included related information but were typically not constructed well.	Paragraphing structure was not clear and sentences were not typically related within the paragraphs.
<b>Mechanics</b>	No grammatical, spelling or punctuation errors.	Almost no grammatical, spelling or punctuation errors	A few grammatical spelling, or punctuation errors.	Many grammatical, spelling, or punctuation errors.
<b>Internet Use</b>	Successfully uses suggested internet links to find information and navigates within these sites easily without assistance.	Usually able to use suggested internet links to find information and navigates within these sites easily without assistance.	Occasionally able to use suggested internet links to find information and navigates within these sites easily without assistance.	Needs assistance or supervision to use suggested internet links and/or to navigate within these sites.



## **Vertebrate Comparison Chart**

### **Overview**

In this summary chart, students will be able to compare physiology of vertebrate organisms. This summary chart works well during Taxonomy units.

### **Objectives**

Students will be able to organize information about the anatomy and physiology of different taxonomic categories

### **Materials**

Vertebrate comparison chart  
Textbook or internet access

### **Procedure**

Students will fill in the chart to compare the different taxonomic categories

# ANIMAL CHARACTERISTICS:

## COMPARISON/SUMMARY CHART

GROUP NAME:	KEY CHARACTERISTICS: What is unique to this group?	TEMPERATURE: Endotherm or Ectotherm?	RESPIRATION and CIRCULATION: How do they breathe? Lungs? How does their blood move?	DIGESTION: How is their food digested?	EXCRETION: Kidneys? Through their skin?	SKIN: Describe their skin! Scales? Fur? Feathers?	REPRODUCTION: External or Internal Fertilization? Viviparous, Ovoviviparous, Oviparous?
<b>Fish</b> Examples: -Jawless fish -Cartilaginous fish -Bony Fish							
<b>Amphibians</b> Examples: -Frogs and Toads -Salamanders and Newts -Caecilians						0	

GROUP NAME:	KEY CHARACTERISTICS: What is unique to this group?	TEMPERATURE: Endotherm or Ectotherm?	RESPIRATION and CIRCULATION: How do they breathe? Lungs? How does their blood move??	DIGESTION: How is their food digested?	EXCRETION: Kidneys? Through their skin?	SKIN: Describe their skin! Scales? Fur? Feathers?	REPRODUCTION: External or Internal Fertilization? Viviparous, Ovoviviparous, Oviparous?
<b>Reptiles</b> Examples: -Lizards and Snakes -Turtles and tortoises -Crocodiles and alligators							
<b>Birds</b> Examples: -perching birds -woodpeckers -marine birds -wading birds -owls -flightless birds -waterfowl							

GROUP NAME:	KEY CHARACTERISTICS: What is unique to this group?	TEMPERATURE: Endotherm or Ectotherm?	RESPIRATION and CIRCULATION: How do they breathe? Lungs? How does their blood move?	DIGESTION: How is their food digested?	EXCRETION: Kidneys? Through their skin?	SKIN: Describe their skin! Scales? Fur? Feathers?	REPRODUCTION: External or Internal Fertilization? Viviparous, Ovoviviparous, Oviparous?
Mammals Examples: -shrews, hedgehogs, moles -bats -primates -anteaters, sloths, armadillos -rodents -rabbits, pikas -carnivores -elephants -manatees -horses, zebra, rhinos -deer, cattle, sheep, pigs, goats, hippos -whales, dolphins, porpoises							

**TITLE OF LESSON PLAN:**

Reptile Adaptations

**LENGTH OF LESSON:**

Two or three class periods

**GRADE LEVEL:**

4-5

**SUBJECT AREA:**

Animals

**CREDIT:**

Jackie Glassman is a freelance writer and editor of educational material.

**OBJECTIVES:**

Students will understand the following:

1. Adaptation describes the changing traits that enable reptiles to live in their environments.
2. Adaptations can be found in physical and behavioral traits of reptiles. Snakes and lizards, turtles, crocodilians, and the tuatara constitute the living orders of reptiles.

**MATERIALS:**

Chalkboard or chart paper

Marker

Internet access

Printer

Classroom Worksheet: Reptile Research (see printable version in the box below)

Take Home Worksheet: Reptile Crossword (see printable version in the box below)

Research resources (e.g., Internet, CD-ROMs, encyclopedia, etc.)

Construction paper

Pencil

## PROCEDURE:

1. Share an amazing fact with students: At one time, giraffes came in a variety of neck lengths. Some giraffes had much shorter necks than modern giraffes. Ask students to brainstorm why short-necked giraffes did not survive. Then offer an explanation of natural selection: The giraffes with shorter necks couldn't compete with long-necked giraffes. Explain that the giraffes were not in an actual contest that they could win by changing their physical characteristics or behavior; they were unknowing participants in a competition that takes place every day in nature: Food supplies are limited so animals must compete for them with other species that eat the same food source. Unlike the giraffes with long necks, short-necked giraffes couldn't reach leaves and twigs up high as well as the ones closer to the ground. Because many animals could eat the low-lying vegetation, fewer short-necked giraffes got enough to eat. Over generations, giraffes with longer necks grew stronger and healthier. The long-necked giraffes had more and more babies that, like their parents, inherited long necks and were better able to survive when food was scarce; no other animal could reach the high leaves as well as they could. Over time, more and more short-necked giraffes died before they could reproduce more short-necked babies. Eventually, only long-necked giraffes were born. This process of change, called "natural selection," happens in all species.

2. Explain that a giraffe's long neck is an **adaptation**, a trait that helps it fit in and survive in its environment. Tell students that sometimes different species within the same family have very different adaptations that depend on location. For example, the Siberian tiger has striped fur while the snow leopard sports a white and black coat. These adaptations allow each species of cat to meet the challenges of its different environment. The Siberian tiger's striped fur keeps it disguised in the dense forest of China; the snow leopard's white fur helps it hide in its snowy environment.

3. On the chalkboard or chart paper make three columns. Label the first column "Animal," the second column "Adaptation," and the third column "Effect." Fill in the first two columns with some sample animals and their adaptations. Then, ask students the effect of each animal's adaptation. Encourage students to add their own ideas to the list. Here are a few examples to start the list:

<b>Animal</b>	<b>Adaptation</b>	<b>Effect</b>
Giraffe	Long neck	Can eat leaves in tall trees (the parts of plants other animals can't reach)
Bird		Flies south in winter; Warmth
Porcupine		Sharp, stiff quills; Can defend itself against enemies
Chipmunk		Hibernate; Can avoid winter food shortages
Dolphin	Tail	Helps it swim

4. Point out the two types of adaptations: physical and behavioral. A polar bear's thick fur, which protects it from the cold, is an example of a physical adaptation. A lizard that "plays dead" to avoid predators is displaying a behavioral adaptation.

5. Invite students to review the adaptations discussed earlier and identify each as either behavioral or physical.

6. Ask students to brainstorm about reptiles, noting their responses on the chalkboard. Add the following traits to the list if the students haven't already (or circle them if they're already on the list), explaining that these are definitive traits of all reptiles:

- breathe through lungs,
- have an internal skeleton with a central backbone (vertebrate),
- are cold-blooded (body temperature is directly related to its surroundings).

7. Explain to the class that reptiles have been living on Earth for over 300 million years. They've been able to survive because of specific traits, both physical and behavioral, that enable them to live in their environments. Then, introduce students to the following types of living reptile with these fun facts:

- Turtles spend most of their lives in the water and have plated shells covering their bodies.
- Lizards have great vision and use their tongues to taste their surroundings.
- Crocodiles lose their teeth chomping on prey, but new sets always grow in.
- Snakes can go a long time without eating, but when they do, their meal is usually another animal.
- The tuatara is similar to a lizard, but the tuatara has a third eye and an extra row of teeth.

8. Divide the class into groups of two or three students. Assign each group one of the following reptiles to research: snapping turtle, rattlesnake, iguana, American alligator, chameleon, tuatara, sea turtle, python, Nile crocodile. You might allow them to select a different reptile of their own choice.

9. Print out and distribute the Classroom Worksheet: Reptile Research to help guide students' research. They will be creating a description of the reptile including what it looks like, where it lives, what it eats, what eats it, and its adaptations.

10. When groups complete their research, instruct them to make a diagram of their reptile with labeled descriptions of the animal's adaptations. Be sure they draw lines from the illustration to each description. If necessary, show models of other types of diagrams.

11. As a fun homework assignment, distribute the Take-Home Worksheet: Reptile Crossword. This short puzzle is a great vocabulary review for students after they have completed the lesson

## ADAPTATIONS:

Instead of dividing the children into groups, present to the class pictures of different reptiles, such as a snake, a turtle, a crocodile, and a lizard. Describe to students where the reptile lives, what it eats, what eats it, and some of its adaptations. Then, have students brainstorm ways each adaptation helps that reptile survive.

## DISCUSSION QUESTIONS:

1. Reptiles have both physical and behavioral adaptations that help them survive in their habitats over time. Name one physical adaptation and one behavioral adaptation from the reptiles you studied.
2. The tuatara is the oldest living reptile. What types of adaptations have enabled this reptile to outlive so many other reptiles?
3. Why do some consider dinosaurs the “original reptiles”? What traits do they share with other reptiles?
4. Almost all reptiles have dry, scaly skin. Think about where most reptiles live, then brainstorm some of the reasons for their skin characteristics.
5. Do a little research on crocodiles and alligators. Why are they both considered reptiles? How are they different from each other?
6. All reptiles are cold-blooded; that is, their body temperature stays about the same as the temperature of their surroundings. What adaptations do reptiles have, both behavioral and physical, that help them survive as cold-blooded creatures.

## EVALUATION:

You can evaluate your students on their research and diagrams using the following three-point rubric:

- **Three points:** research report includes a thorough and well-written description of the reptile including what it looks like, its preys, its predators, and a description of two or more adaptations and how they have helped the animal survive; the accompanying diagram is labeled accurately and includes thorough descriptions of the reptile's various features and adaptations
- **Two points:** research report is adequate and includes some description of the reptile and an explanation of at least one of the animal's adaptations; the diagram is partially labeled with some description of the labeled parts
- **One point:** little research was completed, and descriptions are poorly written; no adaptations are described, or they are described incorrectly; diagram is sketchy and does not included labels with descriptions. You can ask students to contribute to the assessment rubric by determining criteria for well-written research reports and diagrams.



## **EXTENSION:**

### **Comparing Reptiles**

Invite students to work in groups of two or three to create a Venn-like diagram comparing and contrasting different reptiles. How are snakes different from lizards? How are they the same? What are the differences between a crocodile and an alligator? What adaptations do they share?

### **Ancient Reptiles**

The first reptiles appeared over 300 million years ago. One of the most spectacular reptiles—the dinosaur—died out about 65 million years ago. Invite students to research an extinct reptile and describe its adaptations. Encourage them to speculate about why this creature died out.

### **Reptile Models**

Divide children into groups of two or three, and invite them to construct a model of a reptile of their choice. The model, which can be made of clay, play dough, papier- mâché, or any other material, should clearly illustrate one or more of the animal's physical adaptations.

## **SUGGESTED READINGS:**

### **Outside and Inside Snakes**

Sandra Markle. Athenaeum Books for Young Readers, 1995.

Outstanding photographs show snakes in their environment - hatching, hunting, eating, and fighting - and their inside structures - bones, teeth, and internal organs. The engaging, informative text describes how behavior and physical characteristics make a snake ... a snake.

### **Alligators and Crocodiles**

Karen Dudley. Raintree Steck-Vaughn, 1998.

This book is an excellent introduction to the crocodylians, providing information about the physical characteristics, life cycle, behavior, and social organization of alligators and crocodiles. It also describes crocodylians' adaptation to their environment and how they interact with other animals and humans.

### **National Audubon Society First Field Guide: Reptiles**

John L. Behler. Scholastic, 1999.

This field guide includes a substantial introduction to reptile anatomy, behavior, adaptation, and habitat. Included is an identification guide to over 150 species of reptiles with photographs, descriptions, and range maps for each.

#### **WEB LINKS:**

##### **The Birmingham Zoo Animal Omnibus**

Click on "Reptiles" for links to pictures of as many of the species as you can imagine.

<http://www.animalomnibus.com/>

##### **Herp-edia**

This is a collection of reptile species lists. Use this herpetology encyclopedia to find out all the names and classifications one might want or need.

<http://www.herp-edia.com/>

**Melissa Kaplan's Herp Care Information Collection:** All you would ever want to know about herp care, plus some great resources for teachers and students.

<http://www.sonic.net/melissk/index.html>

##### **Reptiles: Sedgewick County Zoo**

This site offers photos and additional information about the physical characteristics, diet, behavior, and environmental status of over 30 reptiles.

[http://www.scz.org/animal\\_exhibits-interactive.php?view=exhibit&exhibit\\_id=2](http://www.scz.org/animal_exhibits-interactive.php?view=exhibit&exhibit_id=2)

##### **Reptiles: San Diego Natural History Museum**

What is a reptile? And what isn't? Learn the answers here along with other frequently asked questions and answers about reptiles.

<http://www.sdnhm.org/exhibits/reptiles/index.html>

#### **VOCABULARY:**

##### **adaptation**

Modification of an organism or its parts that makes it more fit for existence under the conditions of its environment.

**Context:** The African lizard's flat body is an adaptation that enables the reptile to fit into small crevices when threatened by a predator.

**Cold-blooded**

Having a body temperature close to that of the environment.

**Context:** The cold-blooded crocodile needs to sit in the sun to warm up.

**Reptile**

Any of a group of cold-blooded, air-breathing vertebrates that usually lay eggs and have skin covered with scales or bony plates.

**Context:** The reptiles, or class Reptilia, include turtles, crocodilians, the tuatara, and lizards and snakes.

**Scale**

Any of the small stiff flat plates that form an outer covering on the body of some animals, especially fish and reptiles.

**Context:** Most reptiles are covered with horny scales or plates that protect their bodies from drying out.

**Vertebrate**

Having a spinal column.

**Context:** Reptiles are vertebrates; they have an internal skeleton with a central backbone.

**ACADEMIC STANDARDS:****Grade Level:**

3-5

**Subject Area:**

Science

**Standard:**

Understands how species depend on one another and on the environment for survival.

**Benchmarks:**

Knows that an organism's patterns of behavior are related to the nature of that organism's environment (e.g., kinds and numbers of other organisms present; availability of food and resources; physical characteristics of the environment).

**Grade Level:**

3-5

**Subject Area:**

Science

**Standard:**

Understands how species depend on one another and on the environment for survival.

**Benchmarks:**

Knows that changes in the environment can have different effects on different organisms (e.g., some organisms move in, others move out; some organisms survive and reproduce, others die)

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## **Lesson Plan 1**

### **Examine Your Attitudes**

One of the best ways to help students dispel misconceptions about herps is to have them examine their own feelings about the animals. In this part of the lesson, your group can do just that by completing a survey. Afterward, they can help educate others about herps by creating posters and displays.

#### **Objectives:**

- Discuss some of the misconceptions people have about herps.
- Describe ways to improve the image of herps.

#### **Materials:**

- Survey Examine Your Attitudes (Examina Tus Actitudes).
- Poster boards, markers, and other art supplies.

#### **Subjects:**

- Social studies, science, math

#### **Procedure:**

1. Before the activity, make copies of the survey Examine Your Attitudes (Examina Tus Actitudes). Make at least two copies per student – the students will be having parents or friends complete the survey after they've completed it themselves.
2. Start the activity by defining the word "herp" and leading a discussion about the different kinds of herps. (See the background information under Who's a Herp?)
3. Have the students complete the survey, then collect them.
4. Assign the students into small groups. Give the surveys to each group, in turn. Have the groups tally the responses to each question.
5. Discuss the students' answers, using the information under Survey Discussion Points below.

6. Have the groups use the numbers they tallied earlier to create bar graphs of responses for questions 1-4. For questions 5-7, they can calculate percentages.
7. Pass out the extra copies of the survey and have each person ask a parent, neighbor, or friend to complete it.
8. The next day, have the students again work in groups to create bar graphs and calculate percentages based on the new survey responses.
9. Tell the students that they'll be participating in an "education campaign" to help improve the image of herps. To do this, each group should examine their calculations and graphs to decide on what area or areas to focus. Then they can create posters, buttons, and other materials to help dispel myths and negative opinions about herps.
10. Get permission to display the students' creations in a nature center, library, or other public facility.

## **Survey Discussion Points**

### *1. Snakes are mean.*

It's important for students to understand that snakes, like other animals, exhibit a wide range of behavior. Some species of snakes are quite docile, whereas others are more aggressive. Behavior that students may label as "mean," such as eating other animals or biting people, is merely a snake's way of surviving.

### *2. Most herps are ugly and gross.*

It is true that some people think herps are ugly. But, as with other animals, the way a herp looks has been honed by evolution into a "design" that helps the animal survive. For example, a snake's lean, streamlined body can slip into tunnels where mice and other prey animals live.

### *3. Endangered species that are cute or intelligent, such as pandas and whales, should be saved before endangered snakes, frogs, turtles, and other herps.*

People very often favor cute, cuddly, or intelligent animals, but it's important to realize that all species have a role to play in their natural habitats. For example, snakes eat rodents – animals that can sometimes do a lot of damage to crops and spread disease.

### *4. It's O.K. to use the skins of alligators, snakes, and other herps to make shoes, handbags, belts, and other products.*

This is a matter of personal opinion, but it's worth pointing out that, in some cases, harvesting lizards, snakes, and other herps for leather products can cause their populations to plummet. For example, American alligators once bordered on extinction because of overharvesting, but when hunting was halted the animals made a comeback. They are being harvested once again,

but the collection is now carefully regulated.

5. *Touching a toad can give you warts.* False.

6. *Most snakes are poisonous.*

False. Fewer than 10 percent of snakes have venom that can hurt humans.

7. *Reptiles are slimy.*

False. Reptiles have smooth, dry skin.



### Examine your attitude Survey

Circle the answer that best describes your feelings. Be honest! (Don't worry – you won't be graded. And remember: There's no right or wrong answer for many of these questions.)

Key: somewhat agree=1, agree=2, disagree=3

1. Snakes are mean.	1	2	3
2. Most herps are ugly and gross.	1	2	3
3. Endangered species that are cute or intelligent, such as pandas and whales, should be saved before endangered snakes, frogs, turtles, and other herps.	1	2	3
4. It's O.K. to use the skins of alligators, snakes, and other herps to make shoes, handbags, belts, and other products.	1	2	3
5. Touching a toad can give you warts.	True	False	
6. Most snakes are poisonous.	True	False	
7. Reptiles are slimy.	True	False	

## Who's a Herp?

When people talk about herps as a group, they're referring to thousands of species of animals. All of those animals belong to either one of the three major groups of amphibians or one of the four major groups of reptiles. Here's the breakdown:

### *Amphibians*

frogs (including toads)

salamanders

caecilians (little-known animals that look like worms)

### *Reptiles*

snakes, lizards, and worm-lizards

crocodiles

turtles (including tortoises)

tuataras (little-known reptiles that live on islets off the coast of New Zealand)



Alexia Cohen, National Zoological Park

## A Distant Connection

At one time, naturalists thought reptiles and amphibians were close "cousins," which is one reason the two groups were originally put together under the zoological umbrella of *herpetology*. *Herpetology* is derived from the Greek word *herpeton*, meaning "crawling things." But although there's a definite connection – reptiles and amphibians evolved from a common ancestor millions of years ago – the two groups aren't closely related.

Still, reptiles and amphibians have several things in common. For example, both are ectothermic (externally heated), and both usually shed their skin several times a year. Many herps also have special cells that cause the color of their skin to lighten, darken, or change altogether. And many have an organ in the roof of the mouth, called the Jacobson's organ, that senses odor particles.

## Points of Departure

So what's the difference between reptiles and amphibians? Actually, there are quite a few differences. For example, unlike reptiles, amphibians usually lay unshelled eggs in water, while reptiles lay shelled eggs on land. Many young amphibians, equipped with gills, live in water for some time after hatching. Baby reptiles are often miniature versions of the adults while baby amphibians often don't look much like their parents. Young amphibians gradually change into their adult forms through the process of metamorphosis.

Even though some adult amphibians live on land, their skin must remain moist at all times. Their skin produces a coating of mucus and keeps the animals from drying out. Reptiles, in contrast, have scales covering dry skin. So despite what a lot of people grow up believing, snakes, lizards,



and other reptiles aren't the least bit slimy. *That* distinction belongs to frogs, salamanders, and some of the other amphibians.

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## **Lesson Plan 2**



## Herps in History

People and herps go back a long way together! Draw a picture of one or more of the following facts:

In ancient Greece, people believed snakes had healing powers. To cure illnesses, doctors would often allow snakes to crawl on the bodies of sick people.

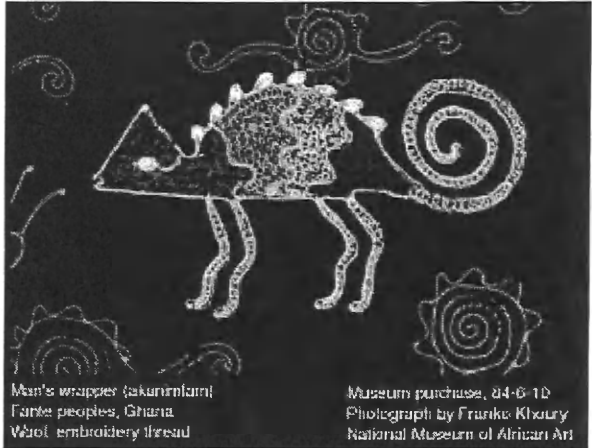
Ancient Chinese fortune tellers sometimes used tortoises to predict the future. They did this by reading the markings on the top of the tortoise's shell.

According to Hindu legend, the powerful god Vishnu rests on the coils of a giant cobra.

In ancient Europe, people called druids believed that certain snakes, or adders, laid magic eggs. These eggs, called "adder stones," were supposed to bring good luck and ward off illness.

There are no snakes in Ireland. According to legend, Saint Patrick drove them all away.

In some parts of Africa, crocodiles were worshipped. Crocodile mummies have been found in Egyptian tombs.



Man's wrapper (ankra)  
Fante peoples, Ghana  
Wool embroidery thread

Museum purchase, 84-B-1D  
Photograph by Franko Khoury  
National Museum of African Art



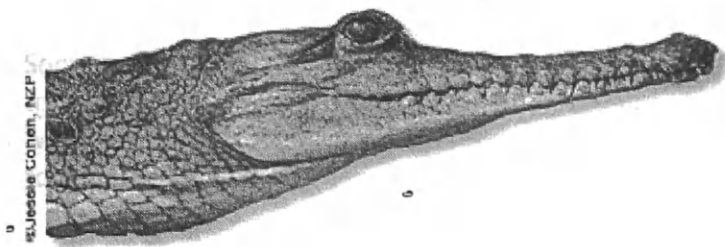
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Photograph by Franko Khoury  
National Museum of African Art

Mayan Indian legend claims that a frog named Uo helps bring rain to the crops. When Uo sings, the rain god sprinkles water onto the Earth from his gourd.

Some Native Americans worshipped a spirit called Frog Woman. Frog Woman was believed to be the creator of the Earth.

During the Middle Ages, people believed that toads had a magic jewel inside their heads. Among other things, these "toadstones" were thought to cure stomach aches.

Early American colonists depicted a rattlesnake on flags showing the 13 colonies.



## Our Views of Herps – Present and Past

Remember when Indiana Jones drops into a room full of writhing snakes? It was a memorable scene from the movie *Raiders of the Lost Ark*, designed to elicit visceral gasps of fear and revulsion. And it's one of the best examples of something screenplay writers and others have known for a long time: snakes and certain other herps have great "horror appeal." The more movies and other media portray herps as creepy creatures, the more people think of them that way.

### Creature Features

Even before herps became typecast as horror-flick villains, they suffered from a fundamental image problem. Most reptiles and amphibians just don't have the cute and cuddly qualities of mammals or the graceful beauty of birds. In fact, many herps seem almost alien, and therefore it's difficult for people to relate to them. We tend to dislike and fear that which is different from ourselves and – even though herps have much more in common with us than many people realize (see *Herps and Humans*) – they certainly *look* different. Picture a snake with its long, limbless body and glassy eyes; a toad with its warty skin; an alligator with its huge, gaping jaws. Remind you of any sci-fi films about creatures from other planets?

### The Threat of Danger

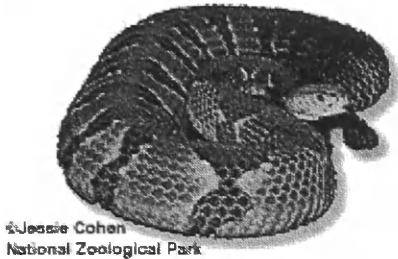
Another factor working against the popularity of herps is that some of them are poisonous. It is true that certain herps produce some of the most toxic substances found in nature, but only a relatively small number of herps pose a threat to people. For example, fewer than 10 percent of snakes have venom that can hurt a human. Still, many people are afraid of all herps and assume that anything slithery, slimy, or scaly is either venomous or dangerous in some other way.

### Crocodile Mummies and Sacred Snakes

Ironically, this basic fear of herps may have a lot to do with the positions of honor they've held in different cultures around the world. Throughout history, people deified those herps they viewed as a threat – probably in an effort to appease the animals and therefore lessen the damage they caused. Crocodiles, powerful predators that are known to claim the lives of careless swimmers and bathers, were sacred animals in ancient Egypt. Their mummified remains are evidence of the respect Egyptians paid these animals. Cobras were also worshipped in ancient Egypt; in India and other Hindu cultures, these snakes are still considered sacred.

## Living Symbols

Some herps, including many harmless species, were valued for their symbolic significance. Consider the tortoise, an animal with a reputation for longevity as some can live more than 100 years. In ancient Japan, wedding gifts portraying tortoises were the givers' way of wishing the newlyweds a long and happy life together.



The perception of what an animal represents isn't necessarily universal, though. For example, what comes to mind when you think of a frog? To many people, frogs are just lowly little creatures that live in swamps. But some cultures view them differently. Because of their close ties to life-giving water, frogs have been seen as symbols of fertility, birth, and crop growth. For example, the Mayans believed that a frog named Uo was responsible for the coming of rain. When the rain god heard Uo's call, he would sprinkle water from his gourd

onto the Earth.

## Links with the Underworld

Opinions of herps took a turn for the worse in Judeo-Christian traditions. For example, the Bible tells of a plague of frogs that overtook the city of Ramses. But the Bible's most sinister portrayal of herps is the serpent in the garden of Eden – a scaly manifestation of evil from the underworld.

Actually, snakes had been associated with the underworld in non-Judeo-Christian traditions for eons. But this association wasn't necessarily considered evil. The world beneath the Earth's surface was the realm of Earth deities, and snakes, with their underground dens and ground-hugging locomotion, were thought to have connections to these powerful beings. Their link to the gods and goddesses of the Earth meant that snakes were creatures deserving of humans' respect.

## **Lesson Plan 3**



### **Which Herp Is Which?**

#### **Objectives:**

By writing to "pen pals" from the point of view of a reptile or amphibian, your students can be creative while learning about how these animals are alike and different.

- List several examples each of reptiles and amphibians.
- Describe how reptiles and amphibians are similar to and different from one another.

#### **Materials:**

- Books and other reference materials on herps.
- Index cards.
- Pencils and crayons or markers.

#### **Subjects:**

- Social studies, language arts

#### **Procedure:**

1. Before the activity, write the names of several types of herps on slips of paper (one for each person). Try to include an equal number of reptiles and amphibians. Depending on the level of your group, you can keep the names general (e.g.: frog, snake) or make them more specific (e.g.: bull frog, garter snake). Write a number on each slip so you can keep track of who has which herp.
2. Hand out the slips of paper you made earlier, taking note of who has which herp. Tell the students to keep the identity of their animal secret.
3. Assign each person a herp pen pal. Try to match reptile with amphibian pen pals.
4. Give the students time to find out about their herps. Then pass out index cards and have the students write "postcards" to their pen pals from the point of view of their particular herps. Explain to the students that they shouldn't give away their herp's identity, but they should give clues that will help their pen pals figure out whether

their herp is a reptile or an amphibian. The information should also be as accurate as possible. (If you're working with more advanced students, you can also have them try to figure out what kind of reptile or amphibian their pen pal represents. You may want to provide a list of the herps you've assigned, to help the students narrow down their choices.)

5. You may want to consider having the students write a series of postcards, with each one revealing a new clue about their identities. Here's an example of one postcard a frog or toad might write:

*Dear Pen Pal:*

*Life is busy these days! I have been practicing very hard on my song. Spring will be here soon, and I have a lot of competition!*

*Signed,  
Me*

6. On the other side of the postcard, have the students draw a picture of their herps' habitats (excluding the herps themselves!).

7. Collect the postcards and hand them out to the appropriate pen pals. Provide resources and give the students time to figure out what kind of herp is their pen pal.

8. Have several of the students read their postcards out loud, then ask for opinions on the kind of herp that "wrote" each card. Finally, have the various pen pals identify themselves.

9. Use the postcards to create a bulletin board display. The focus of the display could be similarities and differences between reptiles and amphibians. (See the background information under *Who's a Herp?*)



## Lesson Plan 4

### Herps and Humans

One reason people often fear or dislike herps is because they perceive the animals as being very different from themselves. But as this part of the lesson demonstrates, herps and humans are amazingly similar.

#### Objectives:

- Identify several internal organs.
- Describe several similarities and differences between the bodies of herps and humans.

#### Materials:

- Herps and Humans activity.
- Posterboard and markers.

#### Subject:

- Science

#### Procedure:

1. Begin by asking the students to name some ways herps' bodies are different from those of humans. Make two columns on the board (one for herps and one for humans) and list the students' ideas.
2. Use the background information under Who's a Herp? to add points the students might not think of. Then tell the students that, despite the differences, herps and humans have a lot in common.
3. Have the students complete the Herps and Humans activity (be sure to see the Herps and Humans answer key).
4. After they've completed the activity, have the students look again at the comparative list you made earlier. Are there any additions or changes the students would like to make?

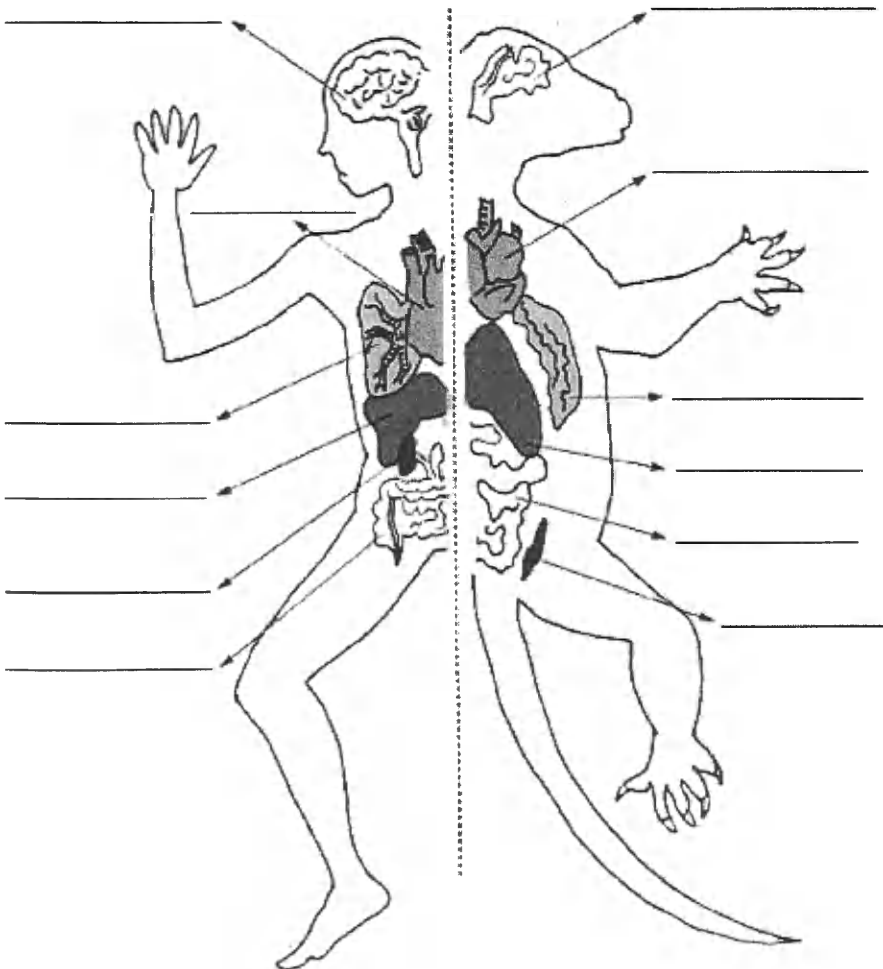


### Extend the Activity!

Have the students make "adaptation posters" with lines pointing to special herp features that humans don't have, along with brief explanations of the feature's survival value. (You can assign the students certain herps to work with, or have them choose their own.) For example, a poster of a tree frog could point out the frog's toe pads, along with a sentence explaining how the toe pads help the frog cling to branches high above the forest floor. The poster could also point out the frog's throat sac, moist skin, bright colors, and so on.

### Herps and Humans

Who says herps and humans are so different? Study the outlines of a person and a lizard below and label the following organs: kidneys, liver, brain, intestines, lungs and heart. Then label the organs.



## Lesson Plan 5

### Design an Exhibit

If you were designing a herp exhibit in a zoo or other facility, what would you want your audience to get out of it – and how would you facilitate their learning? By thinking about questions such as these, your students can review what they know about herps and people's relationships with these animals.

#### Objectives:

- Discuss ways to create an educational herp exhibit.
- Describe several interesting facts about herps.

#### Materials:

- Pictures of herps.
- Art supplies.
- Reference books (optional).

#### Subjects:

- Social studies, science, art

#### Procedure:

1. Assign the students into groups of four. Tell them to imagine that they're exhibit designers at a zoo. Then explain that each group's task is to design a new exhibit at the reptile and amphibian house. As with any zoo exhibit, one purpose of this new exhibit is to display herps and to present facts about the animals and how they live. But it must also help educate people who have misconceptions about herps, such as the idea that toads give people warts or that all snakes are dangerous to people.

The new exhibit must also present information in a way that gets people involved. In other words, the exhibit must have things for people to do – flaps to lift, puzzles to figure out, buttons to push, and any number of other interactive elements.

2. Tell the students that they must first identify several concepts that they would like to get across in their exhibits. Ideas can include thermoregulation (since herps are "cold-blooded" they must rely on external factors such as the sun to keep their temperatures within a comfortable range), how herps attract a mate, how they're affected by pollution, and so on.

3. Have the students choose several herps to include in their exhibits. (The actual exhibits can have pictures of these herps.) They may want to choose herps that exemplify the concepts their exhibits cover, but they're not required to do so.

4. Give the groups time to gather their information and put together their exhibits. (Explain that it's up to them to decide how to divide the work.) You may want to have the students set up the exhibits in an area where the whole school can enjoy them.

5. Have the students give interpretive "tours" of their exhibits.



**TITLE OF LESSON PLAN:**

Reptile Adaptations

**LENGTH OF LESSON:**

Two or three class periods

**GRADE LEVEL:**

4-5

**SUBJECT AREA:**

Animals

**CREDIT:**

Jackie Glassman is a freelance writer and editor of educational material.

**OBJECTIVES:**

Students will understand the following:

1. Adaptation describes the changing traits that enable reptiles to live in their environments.
2. Adaptations can be found in physical and behavioral traits of reptiles. Snakes and lizards, turtles, crocodilians, and the tuatara constitute the living orders of reptiles.

**MATERIALS:**

Chalkboard or chart paper

Marker

Internet access

Printer

Research resources (e.g., Internet, CD-ROMs, encyclopedia, etc.)

Construction paper

Pencil

**PROCEDURE:**

1. Share an amazing fact with students: At one time, giraffes came in a variety of neck lengths. Some giraffes had much shorter necks than modern giraffes. Ask students to brainstorm why short-necked giraffes did not survive. Then offer an explanation of natural selection: The giraffes with shorter necks couldn't compete with long-necked giraffes. Explain that the giraffes were not in an actual contest that

they could win by changing their physical characteristics or behavior; they were unknowing participants in a competition that takes place every day in nature: Food supplies are limited so animals must compete for them with other species and like animals. Unlike the giraffes with long necks, short-necked giraffes couldn't reach leaves and twigs up high as well as the ones closer to the ground. Because many animals could eat the low-lying vegetation, fewer short-necked giraffes got enough to eat. Over generations, giraffes with longer necks grew stronger and healthier. The long-necked giraffes had more and more babies that, like their parents, inherited long necks and were better able to survive when food was scarce; no other animal could reach the high leaves as well as they could. Over time, more and more short-necked giraffes died before they could reproduce more short-necked babies. Eventually, only long-necked giraffes were born. This process of change, called "natural selection," happens in all species.

2. Explain that a giraffe's long neck is an **adaptation**, a trait that helps it fit in and survive in its environment. Tell students that sometimes different species within the same family have very different adaptations that depend on location. For example, the Siberian tiger has striped fur while the snow leopard sports a white and black coat. These adaptations allow each species of cat to meet the challenges of its different environment. The Siberian tiger's striped fur keeps it disguised in the dense forest of China; the snow leopard's white fur helps it hide in its snowy environment.

3. On the chalkboard or chart paper make three columns. Label the first column "Animal," the second column "Adaptation," and the third column "Effect." Fill in the first two columns with some sample animals and their adaptations. Then, ask students the effect of each animal's adaptation. Encourage students to add their own ideas to the list. Here are a few examples to start the list:

#### **Animal Adaptation Effect**

Giraffe: long neck can eat leaves in tall trees (the parts of plants other animals can't reach)

Bird: flies south in winter for warmth

Porcupine: sharp, stiff quills can help to defend itself against enemies

Chipmunk: hibernation can help to avoid winter food shortages

Dolphin tail: helps it swim

4. Point out the two types of adaptations: physical and behavioral. A polar bear's thick fur, which protects it from the cold, is an example of a physical adaptation. A lizard that "plays dead" to avoid predators is displaying a behavioral adaptation.

5. Invite students to review the adaptations discussed earlier and identify each as either behavioral or physical.

6. Ask students to brainstorm about reptiles, noting their responses on the chalkboard. Add the

following traits to the list if the students haven't already (or circle them if they're already on the list), explaining that these are definitive traits of all reptiles:

- breathe through lungs,
- have an internal skeleton with a central backbone (vertebrate),
- are cold-blooded (body temperature is directly related to its surroundings).

7. Explain to the class that reptiles have been living on Earth for over 300 million years. They've been able to survive because of specific traits, both physical and behavioral, that enable them to live in their environments. Then, introduce students to the following types of living reptile with these fun facts:

- Turtles spend most of their lives in the water and have plated shells covering their bodies.
- Lizards have great vision and use their tongues to taste their surroundings.
- Crocodiles lose their teeth chomping on prey, but new sets always grow in.
- Snakes can go a long time without eating, but when they do, their meal is usually another animal.
- The tuatara is similar to a lizard, but the tuatara has a third eye and an extra row of teeth

8. Divide the class into groups of two or three students. Assign each group one of the following reptiles to research: snapping turtle, rattlesnake, iguana, American alligator, chameleon, tuatara, sea turtle, python, Nile crocodile. You might allow them to select a different reptile of their own choice.

9. Have the students create a description of the reptile including what it looks like, where it lives, what it eats, what eats it, and its adaptations.

10. When groups complete their research, instruct them to make a diagram of their reptile with labeled descriptions of the animal's adaptations. Be sure they draw lines from the illustration to each description. If necessary, show models of other types of diagrams.

## **ADAPTATIONS**

Instead of dividing the children into groups, present to the class pictures of different reptiles, such as a snake, a turtle, a crocodile, and a lizard. Describe to students where the reptile lives, what it eats, what eats it, and some of its adaptations. Then, have students brainstorm ways each adaptation helps that reptile survive.

## **DISCUSSION QUESTIONS:**

1. Reptiles have both physical and behavioral adaptations that help them survive in their habitats over time. Name one physical adaptation and one behavioral adaptation from the reptiles you studied.
2. The tuatara is the oldest living reptile. What types of adaptations have enabled this reptile to outlive so many other reptiles?

3. Why do some consider dinosaurs the “original reptiles”? What traits do they share with other reptiles?
4. Almost all reptiles have dry, scaly skin. Think about where most reptiles live, then brainstorm some of the reasons for their skin characteristics.
5. Do a little research on crocodiles and alligators. Why are they both considered reptiles? How are they different from each other?
6. All reptiles are cold-blooded; that is, their body temperature stays about the same as the temperature of their surroundings. What adaptations do reptiles have, both behavioral and physical, that help them survive as cold-blooded creatures?

## EVALUATION

You can evaluate your students on their research and diagrams using the following three-point rubric:

- **Three points:** research report includes a thorough and well-written description of the reptile including what it looks like, its preys, its predators, and a description of two or more adaptations and how they have helped the animal survive; the accompanying diagram is labeled accurately and includes thorough descriptions of the reptile's various features and adaptations
- **Two points:** research report is adequate and includes some description of the reptile and an explanation of at least one of the animal's adaptations; the diagram is partially labeled with some description of the labeled parts
- **One point:** little research was completed, and descriptions are poorly written; no adaptations are described, or they are described incorrectly; diagram is sketchy and does not included labels with descriptions. You can ask students to contribute to the assessment rubric by determining criteria for well-written research reports and diagrams.

## EXTENSION:

### Comparing Reptiles

Invite students to work in groups of two or three to create a Venn-like diagram comparing and contrasting different reptiles. How are snakes different from lizards? How are they the same? What are the differences between a crocodile and an alligator? What adaptations do they share?

### Ancient Reptiles

The first reptiles appeared over 300 million years ago. One of the most spectacular reptiles—the dinosaur—died out about 65 million years ago. Invite students to research an extinct reptile and describe its adaptations. Encourage them to speculate about why this creature died out

## **Reptile Models**

Divide children into groups of two or three, and invite them to construct a model of a reptile of their choice. The model, which can be made of clay, play dough, papier- mâché, or any other material, should clearly illustrate one or more of the animal's physical adaptations.

## **SUGGESTED READINGS:**

### **Outside and Inside Snakes**

Sandra Markle. Athenaeum Books for Young Readers, 1995.

Outstanding photographs show snakes in their environment - hatching, hunting, eating, and fighting - and their inside structures - bones, teeth, and internal organs. The engaging, informative text describes how behavior and physical characteristics make a snake ... a snake.

### **Alligators and Crocodiles**

Karen Dudley. Raintree Steck-Vaughn, 1998.

This book is an excellent introduction to the crocodylians, providing information about the physical characteristics, life cycle, behavior, and social organization of alligators and crocodiles. It also describes crocodylians' adaptation to their environment and how they interact with other animals and humans.

### **National Audubon Society First Field Guide: Reptiles**

John L. Behler. Scholastic, 1999.

This field guide includes a substantial introduction to reptile anatomy, behavior, adaptation, and habitat. Included is an identification guide to over 150 species of reptiles with photographs, descriptions, and range maps for each.

## **WEB LINKS:**

### **The Birmingham Zoo Animal Omnibus**

Click on "Reptiles" for links to pictures of as many of the species as you can imagine.

<http://www.birminghamzoo.com/ao/>

### **Herp-edia**

This is a collection of reptile species lists. Use this herpetology encyclopedia to find out all the names and classifications one might want or need.

<http://www.herp-edia.com/>



## **Melissa Kaplan's Herp Care Information Collection**

All you would ever want to know about herp care, plus some great resources for teachers and students.

<http://www.sonic.net/melissk/index.html>

## **Reptiles: Sedgewick County Zoo**

This site offers photos and additional information about the physical characteristics, diet, behavior, and environmental status of over 30 reptiles.

<http://www.scz.org/animals/reptiles.html>

## **Reptiles: San Diego Natural History Museum**

What is a reptile? And what isn't? Learn the answers here along with other frequently asked questions and answers about reptiles.

<http://www.sdnhm.org/exhibits/reptiles/index.html>

## **VOCABULARY:**

### **adaptation**

Modification of an organism or its parts that makes it more fit for existence under the conditions of its environment.

**Context:** The African lizard's flat body is an adaptation that enables the reptile to fit into small crevices when threatened by a predator.

### **Cold-blooded**

Having a body temperature close to that of the environment.

**Context:** The cold-blooded crocodile needs to sit in the sun to warm up.

### **Reptile**

Any of a group of cold-blooded, air-breathing vertebrates that usually lay eggs and have skin covered with scales or bony plates.

**Context:** The reptiles, or class Reptilia, include turtles, crocodilians, the tuatara, and lizards and snakes.

### **Scale**

Any of the small stiff flat plates that form an outer covering on the body of some animals, especially fish and reptiles.

**Context:** Most reptiles are covered with horny scales or plates that protect their bodies from drying out.

**Vertebrate**

Having a spinal column.

**Context:** Reptiles are vertebrates; they have an internal skeleton with a central backbone.

**ACADEMIC STANDARDS:**

**Grade Level:**

3-5

**Subject Area:**

Science

**Standard:**

Understands how species depend on one another and on the environment for survival.

**Benchmarks:**

Knows that an organism's patterns of behavior are related to the nature of that organism's environment (e.g., kinds and numbers of other organisms present; availability of food and resources; physical characteristics of the environment).

**Grade Level:**

3-5

**Subject Area:**

Science

**Standard:** Understands how species depend on one another and on the environment for survival.

**Benchmarks:** Knows that changes in the environment can have different effects on different organisms (e.g., some organisms move in, others move out; some organisms survive and reproduce, others die)

## **Conclusion**

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This project was designed to provide a resource for teachers to educate students on the beneficial nature of amphibians and reptiles and their unique significance to our ecosystem through the creation of content specific curricula, captive cares guides and ancillary resources. These resources will help educators set up proper care in their classrooms for amphibians and/or reptiles and will allow the animals to become a functional learning tool of the classroom rather than just a 'pet'. Students will become attached to these animals and will be happy to interact with them or even want to be a part of their daily care.

Through the use of these animals, it is hopeful that they will become better known and better received in the public eye rather than the creepy slimy, gross animals that they are often perceived to be. Teachers are the role models in this situation and should be fully responsible for the care and cleaning of the animal and its enclosure and should model proper caretaker roles such as taking the animal to the veterinarian, always providing clean water and bedding and also proper nutrition. As this role model, the teacher educator should provide care over extended vacation breaks or even during the summer (i.e. taking the animal home if necessary). In my school district, animals are taken home by their teacher caretaker and brought back each year to be part of the classroom. During the creation of this thesis, I often wondered what would be best in regards to the work load of bringing home an animal at the end of each school year. Although nothing has been put in place for this type of idea, I thought that it might be interesting to create an 'animal share' within a school or even just the science department of a school where different animals could be rotated within classrooms during the course of a school year. Obviously the participating teachers would need to be committed to the task of caring for these animals as well as the extra care that would be required of them to keep them over a summer. If done properly in a small group of committed educators, I feel like this could be a beneficial way to share the fun and excitement that an animal brings to a classroom while also sharing the workload.

It is my hope, through the creation of this thesis that teachers, students and parents will see the beneficial nature that a live animal brings to a classroom and most importantly the unique qualities that an underdog like an amphibian or reptile can open our eyes to. They continue to be our indicators of change, our living historians of the fossil record and our ever enlightening animals of medical discoveries.

## **Work Cited**

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### **CAPTIVE CARE GUIDE**

#### **\*General Captive Care**

Harding, James. "Critter Care Instructions." *Wildlife & Natural History Q-line*. 2004. Web. 11 July 2011.

<<http://critterguy.museum.msu.edu/Care/>>.

#### **African Dwarf Frog**

Cecere, David. "Dwarf Frog Central." N.p., 2001. Web. 18 Oct. 2011.

<<http://www.davidcecere.pipidae.org>>.

#### **American Toad**

Edmonds, Devin. "American Toad (Bufo Americanus) Care." *Amphibian Care*. 2002. Web. 15 Sept. 2011.

<<http://www.amphibiancare.com/frogs/caresheets/americantoad.html>>.

#### **Axolotl**

Clare, John. "Caudata Culture Species Entry - Ambystoma Mexicanum - Axolotl." *Caudata.org*. N.p., Jan. 2001. Web. 18 Oct. 2011.

<[http://www.caudata.org/cc/species/Ambystoma/A\\_mexicanum.shtml](http://www.caudata.org/cc/species/Ambystoma/A_mexicanum.shtml)>.

"Axolotl Care Sheet - TheAmphibian.co.uk" *Welcome to The Amphibian.co.uk - Frogs, Toads, Newts, Salamanders, Caecilians, Amphibian Care Sheets, Amphibian Facts, Amphibian Photos, Amphibian Forum, Amphibian Downloads and More...* N.p. Web. 18 Oct. 2011.

<[http://www.theamphibian.co.uk/axolotl\\_care\\_sheet\\_Ambystoma\\_mexicanum.htm](http://www.theamphibian.co.uk/axolotl_care_sheet_Ambystoma_mexicanum.htm)>.

## **Bearded Dragon**

Kaplan, Melissa. "Dragons Down Under: The Inland Bearded Dragon." *Melissa Kaplan's Herp and Green Iguana Information Collection*. 2000. Web. 30 Oct. 2011.

<<http://www.anapsid.org/bearded.html>>.

## **Blue Spotted Salamander**

"Blue-spotted Salamander - Ambystoma Laterale - NatureWorks." *New Hampshire Public Television - Engage. Connect. Celebrate*. 2011. Web. 28 Nov. 2011.

<<http://www.nhptv.org/natureworks/bluespottedsalamander.htm>>.

Collicutt, David. "Blue-spotted Salamander (Ambystoma Laterale) in Manitoba." *NatureNorth.com - Manitoba's Online Nature Magazine*. Web. 28 Nov. 2011.

<<http://www.naturenorth.com/spring/creature/bluespot/Fblspot.html>>.

## **Blue Tongued Skink**

Kaplan, Melissa. "Blue-Tongue Skinks." *Melissa Kaplan's Herp and Green Iguana Information Collection*. 2000. Web. 30 Oct. 2011. <<http://www.anapsid.org/bluetong.html>>.

## **Common Musk Turtle**

Stabler, K. 2000. "Sternotherus odoratus" (On-line), Animal Diversity Web. Accessed July 18, 2011

<[http://animaldiversity.ummz.umich.edu/site/accounts/information/Sternotherus\\_odoratus.html](http://animaldiversity.ummz.umich.edu/site/accounts/information/Sternotherus_odoratus.html)>.

Gill, Nadine K. "Sternotherus Oderatus: The Common Musk Turtle." *Tortoise Trust Web - Start Page*. Web. 28>. Nov. 2011. <<http://www.tortoisetrust.org/articles/oderatus.html>>.

## **Crested Gecko**

Spiess, Petra. "Crested Geckos." *Kingsnake.com - the Information Portal for Reptile and Amphibian Hobbyists*. N.p. Web. 18 Oct. 2011.

<<http://www.kingsnake.com/rockymountain/RMHPages/RMHcrested.htm>>.

### **Fat Tailed Gecko**

"African Fat Tailed Gecko Care Guide." *Exotic Reptiles For Sale!* N.p., 2006. Web. 18 Oct. 2011.  
<<http://www.reptilesncritters.com/Care/african-fat-tailed-gecko-care-guide.php>>.

### **Green Frog**

Pauley, Thomas K. *AmphibiaWeb*. 2001. Web. 28 Nov. 2011. <[http://amphibiaweb.org/cgi-bin/amphib\\_query?where-genus=Rana](http://amphibiaweb.org/cgi-bin/amphib_query?where-genus=Rana)>.

### **Green Tree Frog**

Edmonds, Devin. "Green Tree Frog (*Hyla Cinerea*) Care." *Amphibian Care*. 2002. Web. 15 Sept. 2011.  
<<http://www.amphibiancare.com/frogs/caresheets/greentreefrog.html>>.

### **Honduran Milksnake**

"Honduran Milksnake Care Sheet." *Kalamazoo Reptile Show*. N.p. Web. 18 Oct. 2011.  
<<http://www.kalamazooreptileshow.com/CZ/HonduranCareSheet.html>>.

### **Japanese Fire Bellied Newt**

"Fire-Bellied Newt Caresheet. The Amphibian.co.uk." *Welcome to The Amphibian.co.uk - Frogs, Toads, Newts, Salamanders, Caecilians, Amphibian Care Sheets, Amphibian Facts, Amphibian Photos, Amphibian Forum, Amphibian Downloads and More...* n.p. Web. 18 Oct. 2011.  
<[http://www.theamphibian.co.uk/Fire-Bellied\\_newt\\_caresheet.htm](http://www.theamphibian.co.uk/Fire-Bellied_newt_caresheet.htm)>.

Kowalski, Ed. "Caudata Culture Species Entry - Tiger Salamander." *Caudata.org*. N.p., Oct. 2001. Web. 18 Oct. 2011. <[http://www.caudata.org/cc/species/Ambystoma/A\\_tigrinum.shtml](http://www.caudata.org/cc/species/Ambystoma/A_tigrinum.shtml)>.

### **King Snakes**

Kaplan, Melissa. "Kingsnakes and Milksnakes." *Melissa Kaplan's Herp and Green Iguana Information Collection*. N.p., 1994. Web. 28 Nov. 2011. <<http://www.anapsid.org/king.html>>.

## **Leopard Gecko**

Norman, Chris. "Leopard Gecko Care." *Melissa Kaplan's Herp and Green Iguana Information Collection*. N.p., 1995. Web. 18 Oct. 2011. <<http://www.anapsid.org/leopardgek.html>>.

## **Oriental Fire-Bellied Toad**

Plesner, Karsten. "Chinese Fire-Bellied Toad." *Melissa Kaplan's Herp and Green Iguana Information Collection*. N.p., 1996. Web. 18 Oct. 2011. <<http://www.anapsid.org/bombina.html>>.

Staniszewski, Marc. "Marc Staniszewski's Bombina FAQ." *Amphibian Information Centre*. Web. 18 Oct. 2011. <<http://www.amphibian.co.uk/bombina.html>>.

## **Ornate Horned Frog**

Willard, Joshua. "Josh's Frogs How-To Guides » Pac Man Care." *Josh's Frogs - Largest Online Herps Feeders and Reptile Supplies Store*. N.p., 2008. Web. 18 Oct. 2011. <<http://www.joshsfrogs.com/catalog/blog/category/pacmancare/>>.

"Horned Frog Care Sheet - The Amphibian.co.uk. Ornate Horned Frog, Cranwell's Horned Frog, Pacman Frog, Ceratophrys Ornata, Ceratophrys Cranwelli, Captive Care, Feeding, Breeding, Housing and More." *Welcome to The Amphibian.co.uk - Frogs, Toads, Newts, Salamanders, Caecilians, Amphibian Care Sheets, Amphibian Facts, Amphibian Photos, Amphibian Forum, Amphibian Downloads and More...* N.p. Web. 18 Oct. 2011. <[http://www.theamphibian.co.uk/Horned\\_frog\\_care\\_sheet.htm](http://www.theamphibian.co.uk/Horned_frog_care_sheet.htm)>.

## **Painted Turtle**

"Painted Turtle (*Chrysemys Picta*) Care - Darrell Senneke." *World Chelonian Trust - Turtle and Tortoise Conservation and Care*. N.p., 2004. Web. 18 Oct. 2011. <<http://www.chelonia.org/Articles/chrysemyscare.htm>>.

Knipper, K. 2002. "Chrysemys picta" (On-line), Animal Diversity Web. Accessed July 18, 2011 <[http://animaldiversity.ummz.umich.edu/site/accounts/information/Chrysemys\\_picta.html](http://animaldiversity.ummz.umich.edu/site/accounts/information/Chrysemys_picta.html)>.

"Painted Turtle Directory." *GrizzlyRun.com - Pet Care Information*. 8 June 2011. Web. 28 Nov. 2011.

<[http://www.grizzlyrun.com/Pets/Reptiles/Turtles/Painted\\_Turtle/Default.htm](http://www.grizzlyrun.com/Pets/Reptiles/Turtles/Painted_Turtle/Default.htm)>.

### **Red Eared Sliders**

Dewey, T. and T. Kuhrt. 2002. "Trachemys scripta" (On-line), *Animal Diversity Web*. Accessed July 18, 2011

<[http://animaldiversity.ummz.umich.edu/site/accounts/information/Trachemys\\_scripta.html](http://animaldiversity.ummz.umich.edu/site/accounts/information/Trachemys_scripta.html)>.

Kaplan, Melissa. "Red-Eared Sliders." *Melissa Kaplan's Herp and Green Iguana Information Collection*.

1994. Web. 18 Oct. 2011. <<http://www.anapsid.org/reslider.html>>.

### **Red Eyed Tree Frog**

Willard, Joshua. "Josh's Frogs How-To Guides » Tree Frog Care." *Josh's Frogs - Largest Online Herps*

*Feeders and Reptile Supplies Store*. 2008. Web. 18 Oct. 2011.

<<http://www.joshfrogs.com/catalog/blog/category/treefrogcare/>>

### **Red Footed Tortoise**

"Red-foot Tortoise Care - Darrell Senneke and Chris Tabaka DVM." *World Chelonian Trust - Turtle and*

*Tortoise Conservation and Care*. N.p., 2004. Web. 20 Oct. 2011.

<<http://www.chelonia.org/Articles/redfootcare.htm>>.

### **Russian Tortoise**

"Russian Tortoises - Testudo (Agrionemys) Horsfieldii - Darrell Senneke and Chris Tabaka DVM." *World*

*Chelonian Trust - Turtle and Tortoise Conservation and Care*. N.p., 2003. Web. 25 Oct. 2011.

<<http://www.chelonia.org/Articles/russiantortoises.htm>>.

"The Russian Tortoise Care Sheet." *The Russian Tortoise*. 2010. Web. 28 Nov. 2011.

<[http://www.russiantortoise.org/care\\_sheet.htm](http://www.russiantortoise.org/care_sheet.htm)>.



O., Jan. "Care Sheet - Russian Tortoise." *Welcome to ATP*. Web. 28 Nov. 2011.

<<http://www.austinsturtlepage.com/Care/cs-russian.htm>>.

### **Tiger Salamander**

"Welcome to The Amphibian.co.uk - Tiger Salamander (*Ambystoma Tigrinum*) Care Sheet." *Welcome to The Amphibian.co.uk - Frogs, Toads, Newts, Salamanders, Caecilians, Amphibian Care Sheets, Amphibian Facts, Amphibian Photos, Amphibian Forum, Amphibian Downloads and More...* N.p. Web. 18 Oct. 2011. <[http://www.theamphibian.co.uk/Tiger\\_Salamander\\_care\\_sheet.htm](http://www.theamphibian.co.uk/Tiger_Salamander_care_sheet.htm)>

### **White's Tree Frog**

Claims, Ppi. "White's Tree Frogs." *White's Tree Frogs*. n.p., 2011. Web. 19 Oct. 2011.

<<http://www.Whitestreefrog.net>>.

"Whites Tree Frog Care Sheet. The Amphibian.co.uk." *Welcome to The Amphibian.co.uk - Frogs, Toads, Newts, Salamanders, Caecilians, Amphibian Care Sheets, Amphibian Facts, Amphibian Photos, Amphibian Forum, Amphibian Downloads and More...* n.p. 2011. Web. 18 Oct. 2011. <[http://www.theamphibian.co.uk/Whites\\_tree\\_frog\\_care\\_sheet.htm](http://www.theamphibian.co.uk/Whites_tree_frog_care_sheet.htm)>.

### **Wood Frog**

"Wood Frog Care Sheet." *Frogs Archive - Learn Everything About Frogs*. N.p. Web. 28 Nov. 2011.

<<http://www.frogsarchive.com/care-sheets/wood-frog.php>>.

## **GENERAL REFERENCE**

### **Data Sets for Animal Tracking**

Leanne. "Data Sets for Animal Tracking | Pathways To Environmental Literacy." *Pathways To Environmental Literacy | Helping Students Learn About the Ecosystem*. Sept. 2011. Web. 10 Oct. 2011. <<http://devel.lternet.edu/node/47>>.

## **DNR Permits**

"DNR - Permits to Hold Wildlife in Captivity." *SOM - State of Michigan*. 2011. Web. 7 July 2011.

<[http://www.michigan.gov/dnr/0,4570,7-153-31574\\_31580-230540--,00.html](http://www.michigan.gov/dnr/0,4570,7-153-31574_31580-230540--,00.html)>.

## **How to find a reputable pet store**

"How to find a reputable pet store." *eHow.com*. eHow. n.d. Web. 15. July. 2011.

<[http://www.ehow.com/how\\_2057547\\_find-reputable-pet-store.html](http://www.ehow.com/how_2057547_find-reputable-pet-store.html)>

## **Michigan Partners in Amphibian and Reptile Conservation**

"PARC Guidelines and Positioning Statements." *Partners in Amphibian and Reptile Conservation*. 2011.

Web. 1 Jan. 2011. <<http://www.parcplace.org/publications/134-parc-guidelines-and-position-statements.html>>.

## **Mauritius Society for the Prevention of Cruelty to Animals**

"Statements of Belief." *MSPCA Homepage*. Web. 19 July 2011. <<http://www.mspca.org>>.

## **Text Reference**

Stebbins, Robert C., and Nathan W. Cohen. Introduction. *A Natural History of Amphibians*. Princeton, NJ: Princeton UP, 1995. 1-9. Print.

Bartlett, Richard D. *The 25 Best Reptile and Amphibian Pets*. Hauppauge, NY: Barron's, 2006. Print

## **Veterinarian List**

"ARAV." *ARAV Redirect*. Web. 19 July 2011.

<[http://www.arav.org/ECOMARAV/timssnet/common/tnt\\_frontpage.cfm](http://www.arav.org/ECOMARAV/timssnet/common/tnt_frontpage.cfm)>.

*Reptile Information, Forums, Care Sheets, and More. All Your Reptile Information Needs!* -

*RepticZone.com*. Web. 19 July 2011. <<http://www.repticzone.com>>.