REPTILES AND AMPHIBIANS
MIDDLE SCHOOL

Life Science TEKS

Sixth Grade:	6.12D, 6.12E
Seventh Grade:	7.10A, 7.10B, 7.11B, 7.12A, 7.12B, 7.12C, 7.13A, 7.13B
Eighth Grade:	8.11A, 8.11B, 8.11C, 8.11D

Vocabulary

amphibians, aquatic, biodiversity, caecilians, deformity, ecosystem, fertilizer, gastrolith, macroinvertebrate, metamorphosis, motor neurons, nervous system, pesticide, pH, reptiles, salamanders, sensory neurons, spinal cord, vertebrae

Pre-Show Activity

Pre-Show Lesson: Effect of Pesticides on Amphibians

Post this question on the board: "What is so special about amphibians?"

Materials:

Per group: water sample from a local stream or pond (sample must be fresh and contain debris from the bottom and edges of the water), macroinvertebrate identification charts, 5 small beakers or jars to set up miniature water ecosystems, dissecting microscope and hand lenses, 5% fertilizer solution in dropper bottles, 5% pesticide solution in dropper bottles, pH paper or pH probe, pipettes

Note: Aeration of the samples is preferable during the 24 hour period, because of the susceptibility of some of the aquatic organisms to environmental changes. The organisms which are the most susceptible are the ones which are intolerant to pollution. As the dissolved oxygen levels decrease, the organisms will rapidly die off. The dissolved oxygen levels begin to decrease almost immediately after the sample is taken from the water.

Per student: student record sheet for Pesticide Experiment (A-1), safety goggles and an apron or lab coat

Procedure:

* Safety goggles and aprons should be worn at all times during this lab.

1. The teacher will read a book comparing reptiles and amphibians. A good book to read is *Firefly Encyclopedia of Reptiles and Amphibians* by Chris Mattison. You may want to mark the pages you want to read ahead of time. Students will create a Venn diagram to compare the likenesses and differences of reptiles and amphibians. Share these in small groups.

2. Tell students that they are going to use what they have learned about amphibians to discuss the following question in small groups: "How do you think that pesticides would affect an amphibian's life? Why?"

3. Students will participate in an experiment investigating the effects of pesticides on an aquatic habitat. This experiment was adapted from: http://www.ncsu.edu/sciencejunction/depot/experiments/water/lessons/macro/macrolesson3.htm

   Experiment Procedure:

   1. Working in small groups, take an approximate 1000 ml sample of the water including the debris.

   2. Pour a portion of the sample into a petri dish and examine it under low power on the microscope or with a hand lens.

   3. Using the identification charts, identify the predominant species of macroinvertebrate and determine the pH level of the sample. You can find a macroinvertebrate chart on the Internet. One site is http://www.discovercarolina.com/html/s05nature09a02b.pdf.

   4. Once an identification has been made and the pH has been determined, separate the 1000 ml sample into five 200 ml samples in separate containers. Label each container in the following manner and add the listed amounts of fertilizer and pesticide solution to the properly labeled container.

Container One:	5 drops of 5% fertilizer solution
Container Two:	20 drops of 5% fertilizer solution
Container Three:	5 drops of 5% pesticide solution
Container Four:	20 drops of 5% pesticide solution
Container Five:	control (add nothing)

5. Do not add anything to Container Five. This is the control. Place containers in a location where they will not be disturbed for a 24 hour period.

6. Hypothesize about how the contents of each container will change after the 24-hour period. In your hypothesis include a statement about pH.

7. After the 24-hour period, observe the contents of each container. Record your observations in the data table in Appendix A-1. Determine the pH of each container and record the number in the data table.

4. Debrief with students about the experiment. Discuss how amphibians are affected by pesticides in an aquatic habitat. Show students pictures of deformed frogs. Lead students to understand the importance of frogs in the biodiversity of an aquatic ecosystem.

Teacher Background:

Amphibians, a class of vertebrates consisting of frogs and toads, salamanders, and caecilians, are excellent organisms for middle school science students to study because of their ecological significance. Because they exchange oxygen and carbon dioxide through their skin, amphibians absorb any chemicals or substances present in their immediate environments; malformations in or the absence of amphibians may suggest a problem in a given ecosystem.

Did you know that middle school students have made scientific discoveries of global significance? In 1995, frog malformations were discovered by an adventurous middle school teacher and her after-school science club in Minnesota. On a routine field trip to a nearby pond, students noticed that frogs had missing or extra limbs that inhibited their mobility, and that frogs closer to the pond were more abnormal, suggesting that something in the water was causing these malformations (Souder 2000). The discovery of these frogs triggered a scientific investigation of malformed amphibians worldwide. To date, 44 U.S. states have reported amphibian malformations from almost 60 species (NBII 2006), and this malformation phenomenon is a global problem, as well (Ouellet 2000).

Amphibians have three distinct life stages: egg, larva, and adult. In anurans (frogs and toads), the larval stage is a tadpole, which transforms into an adult by completing metamorphosis. Anurans' development from tadpole to adult may be very rapid or quite slow, depending on the species and environmental factors. For example, metamorphosis may accelerate when breeding areas become overcrowded or begin to dry, and human activities involving pesticides and other chemical contamination probably produce environmental cues that slow, speed up, or cause other negative effects during metamorphosis. If chemical communication between developing cells is interrupted, a malformation will be produced. Some malformations occur naturally, due to developmental

fluctuations in nature or because of UV radiation, fungi, or trematodes (naturally occurring parasitic worms that use tadpoles as hosts) (Hamilton 2004; Meteyer 2001). Changes in mechanical factors (e.g., accidental limb amputation) later in life are considered deformations (Meteyer 2001); a malformed frog is not the same as a deformed frog. Amphibian declines have occurred on a global scale in recent decades and may be the result of amphibian malformations, which decrease the overall health of individual amphibians, causing local populations to suffer. Global phenomena (e.g., climate change) may also play important roles in amphibian decline, making specific causes more difficult to pinpoint.

Source: NSTA, January 2007 Sciencescope 29, Populations & Ecosystems

Post-Show Enrichment Activities

Activity One: Show Review

Procedure:

1. The teacher will review facts/non-facts from the show. Students will put a thumbs up if they agree or a thumbs down if they disagree.

Possible facts: (Change a word to make it incorrect.)

- A snake is a reptile.
- Scientists believe that amphibians have been around longer than dinosaurs.
- A female crocodile protects the nest.
- A male crocodile will eat his baby crocodile.
- Some alligators swallow rocks, or gastroliths, to help them smash up the food in their stomach.
- Blue is a warning color.
- Alligators are only found in the United States and China.
- Lizards blink and snakes do not.
- Lizards can hear and snakes cannot.
- Turtles can live in land or water.
- The shell of the turtle is the backbone and ribs.
- Sea turtles cannot pull any part of their body into their shell.
- A snake smells with its tongue.

Activity Two: Frog Dissection

Materials: internet, science textbook or resources

Procedure:

1. Students will compare the frog anatomy to human anatomy. Students will use the web site http://www.mhhe.com/biosci/genbio/virtual_labs/BL_16/BL_16.html to study the frog systems (organism level, circulatory, digestive and urogenital).

2. Students will use a science textbook, resource books or the Internet to study the human anatomy.

3. Students will complete a Venn diagram for each of the systems listed comparing the frog's parts to a human's anatomy.

Activity Three: Frog Extinctions: An Environmental Crisis

Materials: Reading from Appendix A-3

Procedure:

1. Divide students into groups of three. Assign one section of the reading to each person in the group: “The Crisis”, “Frogs as Eco-Health Indicators”, and “How to Help” (see Appendix A-3).
2. Students should find someone reading the same section as their assigned section. They will read their section with this partner to become a partner of their section.
3. Students will return to their original group and share the information contained in their section.
4. Each group will create an advertisement for a science journal which depicts the important information in the article. The ad should have a persuasive tone to it.

Appendix

A-1

Pesticide Experiment

Procedure: Draw or explain your procedure below.

Hypothesis:

Pesticide Data Table:

Containers	Additions to containers	pH	Observations
1	5 drops of 5% fertilizer solution	1.	1.
2	20 drops of 5% fertilizer solution	2.	2.
3	5 drops of 5% pesticide solution	3.	3.
4	20 drops of 5% pesticide solution	4.	4.
5-control	No additions	5.	5.

After the observations are complete, answer the following questions.

Conclusions:

1. Does the data collected support your hypothesis? Explain.

2. Based on your observations, in which container was the survival rate of macroinvertebrates the highest? Why?

3. Based on your observations, does the addition of pesticides and fertilizers to an ecosystem cause a disruption in the ecosystem? If it is disrupted, how is it disrupted?

4. What are some possible causes for an increase in the fertilizer or pesticide levels in an aquatic ecosystem?

5. What other factors may have had an effect on the changes of your aquatic systems?

6. Could pesticides affect the frog population? Explain your answer.

A-2

Frog Deformations

Source: National Science Foundation
http://www.nsf.gov/news/news_images.jsp?cntn_id=110105&org=NSF

Nutrient Pollution Drives Frog Deformities by Ramping Up Infections

Farming nutrients drive parasitic infections that in turn cause frog leg deformity.

Credit: *Courtesy Pieter Johnson, University of Colorado at Boulder*

Infectious parasites cause missing limbs, extra limbs and other malformations in frogs.
Credit: *Courtesy Pieter Johnson, University of Colorado at Boulder*

Environmental factors causing frog deformities were a mystery until this study.
Credit: *Courtesy Pieter Johnson, University of Colorado at Boulder*

A-3

Frog Extinctions - An Environmental Crisis

By Kerry Kriger, Ph.D., SAVE THE FROGS! Founder and Executive Director,
and Michael Starkey, Chair of SAVE THE FROGS! Advisory Committee

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The Crisis

Frog populations have been rapidly disappearing worldwide, and nearly one-third of the world's amphibian species are endangered and on the verge of extinction. Approximately 200 amphibian species have disappeared since 1979 – many from seemingly pristine wilderness areas, such as national parks. Amphibians are currently going extinct several thousand times faster than they should be naturally, which is why this is one of the world's most serious and overlooked environmental crisis.

Amphibians are important for maintaining balance in the ecosystem, which allows humans to derive many direct benefits from frogs. For instance, adult frogs eat large quantities of

insects, including disease vectors transmitting fatal illnesses to humans (e.g. mosquitoes/malaria). They also eat agricultural pests that would destroy crops if their populations were not kept under control. Frogs act as natural pesticides, reducing dependence on potentially harmful chemical pesticides. India and Bangladesh banned exportation of frogs for food in the late 1970s when they realized mosquito populations were increasing as frog populations declined.

Frogs, their tadpoles and eggs also serve as an important food source to a diverse array of predators, including dragonflies, fish, snakes, birds, beetles, centipedes and even monkeys. Thus, the disappearance of frog populations disturbs an intricate food web and results in negative impacts that can cascade through the ecosystem.

Most people in the United States depend on water from a community filtration system, so in these tough economic times it is great to have tadpoles around. They keep waterways clean by feeding on algae, thus reducing costs associated with water filtration.

Frogs as Eco-Health Indicators

Amphibians also serve as bio-indicators. Like the proverbial “canary in a coal mine,” amphibians are an early warning system sounding the alarm of environmental degradation. Most amphibians are dependent on both terrestrial and aquatic environments, and they have permeable skin that can easily absorb toxic chemicals. They are also slow to move, making it difficult for them to find a new home if their habitat is destroyed. These traits make frogs especially susceptible to environmental disturbances, which is why the health of frogs may be indicative of the health of the biosphere as a whole.

Amphibians produce a wide array of skin secretions, many of which have significant potential to improve human health through use as pharmaceuticals. Approximately 10 percent of Nobel Prizes in Physiology and Medicine have been awarded to scientists whose research depended on amphibians. When a frog species disappears so does any promise it holds for human health.

Frogs and other amphibians

face an array of human-induced threats, and many species are likely to become extinct if people don't change their behavior. Six major factors negatively affecting amphibians are: habitat destruction, infectious diseases, pollution and pesticides, climate change, invasive species and over-harvesting for pet and food trades. To worsen matters, many of these threats act in concert with one another to create synergistic (magnified) effects. For instance, exposure to a particular pesticide may not normally kill frogs, and a certain disease may only make frogs mildly ill. However, if they become infected by a disease after a pesticide has compromised their immune systems, the population may experience a lethal disease outbreak and be driven to local extinction. And, if a significant portion of the species' remaining habitat has already been logged, invaded by introduced species or become unusable due to altered rainfall patterns, the species could be on a rapid path toward global extinction.

How to Help

The rapid disappearance of amphibian populations in recent decades is undoubtedly the most tragic loss of biodiversity ever witnessed and one of the most serious environmental issues. Fixing a problem of this magnitude requires a collaborative effort on the part of scientists, politicians, educators, businesses, members of the media and high-profile personalities, such as actors and musicians. They can quickly influence public opinion and bring an obscure issue (such as amphibian declines) to the forefront of public consciousness. It also requires a concerted effort on the part of average citizens, all of whom have the ability to reduce their environmental impact, to exert an influence on elected officials and businesses they choose to support.

(1) Do not use pesticides. Pesticides and herbicides are toxic chemicals that generally undergo little to no testing on amphibians prior to their approval. Many of the U.S.'s 18,000+ registered pesticides can cause immunosuppression, sexual deformities or even death. Unfortunately, the law of gravity allows pesticides to end up in waterways where amphibians live and breed, thus causing untold damage due to their highly absorbent, permeable skin. Therefore, clean water is not only good for humans but also for wildlife.

(2) Do not eat frog legs. Europeans consumed roughly 120 million frogs per year in the 1990s. The harvesting of amphibians for the food trade is often unregulated, and in many underdeveloped countries, such as Thailand, is likely a primary contributor to

amphibian declines. Even in countries where the import/export of endangered species is controlled, virtually no protocols or laws are in place to ensure that diseased amphibians do not get transported. While most of the world's frog legs come from wild-caught frogs, American Bullfrogs (*Rana catesbeiana*) are commonly farmed and transported worldwide. They are known carriers of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) and, thus, are likely primary contributors to global spread of chytridiomycosis, a disease that has decimated amphibian populations worldwide.

In a recent study, 62 percent of farm-raised bullfrogs sampled in Los Angeles markets were infected. California imports several million bullfrogs each year, many from farms in Taiwan and China. Bullfrogs are also quite adept at establishing populations in areas where they are introduced. They are large and compete with native amphibians for food and shelter, thus making them a harmful invasive species when outside their natural range (the eastern United States).

(3) Do NOT purchase wild-caught amphibians. Ever wonder where frogs in pet stores come from? Most were taken from their homes in the wilderness. Several million wild-caught amphibians are legally imported into the U.S. each year, and thriving global trade exists as well. The black-market trade – often in legally protected species – compounds the problem. Be part of the solution by not having an amphibian as a pet, or by only buying captive-raised native species.

(4) Slow down driving on wet nights. Frogs and salamanders like to take their time crossing the road . . . give them a break! More than 700 million cars are on the planet, so it is no surprise that roadkill is a significant cause of frog mortality in many urban and suburban areas.

(5) Be like a frog and go green. Humans live on a planet with finite resources and a growing population of 7+ billion people. People need to reduce, re-use and recycle as much as possible in order to conserve natural resources for future generations and to reduce the need for logging, mining and drilling. Water conservation is amphibian conservation, so turn off the tap whenever possible. Use rechargeable batteries; they save money and keep heavy metals out of the environment. Don't purchase bottled water because production of plastics harms the environment and fuel is wasted to ship bottled water to local stores.