TRYING TO SAVE THE WORLD'S AMPHIBIANS

Introduction

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Focus
This *News in Review* module examines the decline of frog and other amphibian populations around the world. It looks at the factors, largely human-made, that have caused this reduction. It also describes some of the efforts being made to save these valuable creatures from extinction.

The world's frogs are in serious trouble.

Amphibian populations around the world are rapidly declining. Every year new species are becoming extinct. In some cases, newly discovered species are extinct even before scientists can classify and name them.

The class Amphibia includes not only frogs but also toads, newts, salamanders, and worm-like creatures called caecilians. They have survived on Earth from between 300 million and 400 million years. They've been around since before there were dinosaurs. There are now more than 6 000 individual species of amphibians.

But that number is declining. Today at least one-third of amphibian species are considered threatened—and that percentage increases yearly. The problem is especially problematic in tropical areas. Ecuador, for example, has 448 identified frog and toad species. At least 30 of these are now extinct, and another 250 are considered endangered or threatened.

In many cases the decline has been rapid. Once-common species have disappeared so fast that no samples have been preserved. All that remains of them are photographs.

The causes of this disappearance are various, but researchers have a list of four to which they attribute most of the blame. These are habitat loss, increased ultraviolet radiation, pollution, and chytrid, a fungus that attacks the skin of frogs. Chytrid has been especially devastating among tropical frogs, but it is now showing up in other areas—including Canada. Many scientists believe that global warming has made the rapid spread of this fungus possible.

In an attempt to call attention to the plight of amphibians, conservation groups around the world celebrated 2008 as the Year of the Frog. Zoos and research facilities in Canada and internationally have ramped up their efforts to save a variety of different species.

Several species of amphibians now survive mostly—or only—in captivity. Breeding programs around the world are attempting to keep these species alive and viable. The ultimate aim of most programs is to reintroduce the animals into their natural habitat. But that habitat will have to improve if reintroduction is to be successful.

Scientist often describe amphibians as "the canary in the coal mine"; as long as they are doing fine, so will the rest of life on Earth, including humanity. Their decline should be a wake-up call for all of us. We ignore this at our own peril.

To Consider

Is your community "amphibian-friendly"? While you were growing up, were there places in your community where you could always find frogs or toads? Do those places still exist?

TRYING TO SAVE THE WORLD'S AMPHIBIANS

Video Review

Did you know . . .
All of Ontario's frogs and toads lay their eggs in water, which later hatch into tadpoles. Eggs may be laid in strings, as with toads, or in clusters or mats, and they may be laid on top of or below water, where they are attached to aquatic vegetation.

Pre-viewing Activity

Before watching the video, make a brief list of three to five reasons why you feel amphibians are important and why we should work to preserve them. You will revisit this list after you have watched the video.

Video Questions

Answer the following questions in the spaces provided.

1. a) What percentage of the world's amphibians faces extinction?

   b) What percentage is in serious decline?

2. What is chytrid?

3. What is the most endangered amphibian in Canada?

4. a) Where in Canada can Oregon spotted frogs be found?

   b) How widespread are they?

5. What was the last-known remaining habitat for the Puerto Rican crested toad?

6. According to Jeff Ettling, what do most of the factors impacting on amphibian populations have in common?

7. What was most unusual about the now-extinct gastric brooder frog?

8. What part of an amphibian's body most intrigues biologist David Green?

9. How many amphibian species is Amphibian Ark trying to save?

Post-viewing Activities

1. After watching the video, revisit the list you made in the Pre-viewing Activity. Are there any additions (or deletions) you would make as a result of your viewing?

2. The video describes the activities of Amphibian Ark and its attempts to preserve a variety of species of amphibians even as they go extinct in the wild. But some scientists question the value of such an approach, arguing that no one has any idea when, or under what circumstances, these amphibians could be returned to the wild.

   Consider the opinion of Australian scientist Ross Alford: "Any commitment to long-term captive maintenance of a species is effectively an infinite commitment of time and resources. The idea that we have any hope of doing that for more than a tiny handful of particularly charismatic species is clearly wrong" (*Nature*, March 27, 2008).

   Do you agree with Alford that Amphibian Ark's attempts are over-ambitious? Or do you think, like Jeffrey Bonner, that the attempt to save a large number of species should be made—even if we can't be sure we'll succeed? Write a response to this question in the space provided.

TRYING TO SAVE THE WORLD'S AMPHIBIANS

YV *Current Status*

Quote
"Currently, a third of all amphibian species, nearly a third of reef-building corals, a quarter of all mammals, and an eighth of all birds are classified as 'threatened with extinction.' These estimates do not include the species that humans have already wiped out or the species for which there are insufficient data. Nor do the figures take into account the projected effects of global warming or ocean acidification. Nor, of course, can they anticipate the kinds of sudden, terrible collapses that are becoming almost routine." — Elizabeth Kolbert (*The New Yorker*, May 25, 2009)

Did you know . . .
Chytridiomycosis is a disease caused by a fungus called *Batrachochytrium dendrobatidis*. It is usually referred to as the chytrid fungus or just chytrid.

For nearly 75 million years they were Earth's dominant animal. Now they are on the verge of disappearing.

The statistics tell the story: "Of 5 743 known species of amphibians, 43 per cent are declining, 32 per cent are threatened, and nearly three per cent (168 species) are believed to be extinct" (www.cbc.ca/news/story/2007/05/01/amphibians-climate.html). All over the world, frogs and their fellow amphibians are rapidly disappearing.

More than half of the frogs, toads, and salamanders in the Mediterranean basin are unique to the area. Over 25 per cent are now considered endangered. One species of frog—the painted frog—has already been declared officially extinct.

In the tropics the story is even sadder. Consider the situation in Ecuador, where over half the frog population is believed to be endangered, and at least 30 species are considered extinct. The capital city of Quito once had eight native species of amphibian. Now there are only two left, and one of them is endangered. Two-thirds of the harlequin frogs from throughout the American tropics are believed to be gone.

According to the Global Amphibian Assessment, "The largest numbers of threatened species occur in Latin American countries such as Colombia (214), Mexico (211), and Ecuador (171). However, the highest levels of threat are in the Caribbean, where more than 80 per cent of amphibians are threatened or extinct in the Dominican Republic, Cuba, and Jamaica, and a staggering 92 per cent in Haiti" (www.iucnredlist.org/amphibians/key_findings).

Nor is Canada exempt from the trend. Quebec has 20 species of amphibians. One of these, the western chorus frog, is already on the threatened list. Five more are expected to soon be in the same position. Other Canadian amphibians on the threatened list include the American bullfrog and the coastal tailed frog. The Oregon spotted frog is the most vulnerable; it has only two known habitats remaining in British Columbia.

What Went Wrong

"Hardy and plentiful as they seem, frogs are actually very frail things, with a semi-permeable skin that leaves them vulnerable to even the smallest hiccup in their environment" ("Why are these frogs croaking? Massive die-offs in the American tropics are an early warning of the effects of global warming" by Jeffrey Kluger, *Time*, January 23, 2006).

Scientists attribute most of the decline to two major human-caused factors. The first of these is the destruction of habitat—usually caused by human development—which is exactly what is happening in the areas where the western chorus frog exists. The second is overexploitation of resources, which destroys things such as the food chain on which the amphibians depend. Sometimes it is the result of competition with new species introduced into the environment by humans.

Chytridiomycosis

Chytridiomycosis, a fungus-caused disease, has recently become one of the main threats to frog populations around the world. It was only in the mid-1990s that scientists discovered that chytrid was wiping out huge numbers of frogs in Australia and Central America. The disease has now been reported on every continent where frogs live (there are no frogs in Antarctica) and in 43 different

countries. Chytrid is believed to have contributed to the decline of at least 93 amphibian species around the world.

The disease was first discovered on African clawed frogs in South Africa in 1938. Ironically, this frog was traded globally from the 1930s through the 1950s because it was used as a live pregnancy test (the urine of a pregnant woman stimulates the frog to produce eggs). It is thought that this trade helped spread chytrid around the globe.

Trade in North American bullfrogs may also have contributed to the spread of the disease. Bullfrogs are valued by gourmets for their delicious legs, and live frogs are traded around the world.

The chytrid fungus spreads by generating microscopic spores that disperse in water and can easily travel rapidly in streams and runoff throughout a region.

Scientists are still unsure why chytrid is such a killer. They have established that it attacks keratin, a protein in the amphibian's skin and mouthparts. They speculate that this hampers oxygen exchange as well as the control of water and salts in the body. Recent research seems to indicate that it leads to electrolyte imbalances resulting in heart failure.

Frog eggs cannot be infected, but tadpoles can carry the fungus on their mouthparts. Once they metamorphose, the fungus invades their skin. The disease is virulent, easily transferred from one frog to another. It seems to be able to live on almost any frog or toad; but not all species are susceptible to it.

Habitat loss, exploitation, and chytrid give us some answers to explain the decline in amphibian species—but not all the answers. The last word, from Global Amphibian Assessment – 2008, is indeed distressing: "Perhaps most disturbing, many species are declining for unknown reasons, complicating efforts to design and implement effective conservation strategies" (www.iucnredlist.org/amphibians/key_findings).

TRYING TO SAVE THE WORLD'S AMPHIBIANS
YV *Impact of Global Warming*

Quote
"Today's amphibians have taken not just a one-two punch, but a one-two-three-four punch. It's death by a thousand cuts. . . . Habitat destruction, the introduction of exotic species, commercial exploitation, and water pollution are working in concert to decimate the world's amphibians. The role of climate change is still under debate, but in parts of the Andes, scientists have recorded a sharp increase in temperatures over the past 25 years along with unusual bouts of dryness." — University of California, Berkeley, biologist David Wake, (*National Geographic,* April 2009)

Did you know . . .
The harlequin frog got its name from the fact that its bright markings make it appear to be wearing a jester's costume. These frogs are usually a combination of black and some starkly contrasting colour such as yellow, green, orange, or red.

Many scientists who study amphibians are coming to believe that global warming is playing a significant role in their decline. How significant a role remains a matter of debate.

Impact of the Chytrid Fungus
In tropical regions, the chytrid fungus has become one of the main causes of population decline. Recent studies indicate that the spread of chytrid in these areas has been promoted by warming trends.

Studies of harlequin frogs in Central American cloud forests have shown a direct relationship between the effects of global warming and frog deaths. As the years grow warmer, the number of species die-offs increases. After a warm year, frog deaths rise by about 80 per cent.

Chytrid is actually a fungal disease that prefers cooler temperatures, from 17 to 25 degrees Celsius. So how does a warming trend increase its effectiveness? Isn't this the exact opposite of what one might expect?

According to the journal *Environment* (May 2006), warming in tropical cloud forests has a doubling effect. It raises nighttime temperatures into the optimum range for the fungus. But it also increases daytime cloudiness, keeping forest temperatures from climbing above 25 degrees and making it impossible for amphibians to find warm refuge from chytrid. Cooler days and warmer nights have become the perfect breeding ground for this disease.

From 1975 to 2000, tropical temperatures rose three times as fast as the 20th century average. This trend is only expected to continue, making conditions for tropical amphibians even worse.

Human Implications
Scientists are paying special attention to the effects of climate change on the chytrid fungus because it is an object lesson on the effects of climate change on disease.

Scientists often refer to frogs as an indicator species. They are a particularly sensitive animal, one of the first to react to changes in their environment. Climate change appears to have made them especially susceptible to chytrid.

El Cope National Park in Panama is one area where the effects of chytrid are being closely studied. The disease swept through the area and in one four-month period killed 50 per cent of the amphibians. It reduced the overall number of amphibian species by almost 50 per cent. James Collins, one of the scientists studying the disease, was quoted as saying, "There are only a few examples where we think a pathogen resulted in extinction of a species in an area. This is one of them" (*Environment*, May 2006).

The relationship between chytrid and climate change is one more example of the relationship between disease transmission and global warming. Warming in the Arctic and sub-Arctic has modified the life cycle of nematode parasites in musk oxen, which is having a significant impact on the survival of those animals. Yet another example is the spread of another fungus, pine blister rust, in forests in the Rocky Mountains.

Many scientists believe that what is happening to amphibians, thanks to climate change, is only the beginning. Andrew R. Blaustein and Andy Dobson, writing in *Nature* (January 12, 2006), warned that we should expect creatures ranging from ants to zebras to

be confronted with challenges similar to those facing frogs. They argue that the current models built to identify animals at risk of extinction take into account the relationships between climate and disease. "The frogs are sending an alarm call to all concerned about the future of biodiversity and the need to protect the greatest of all open-access resources—the atmosphere."

Of course, climate change has the potential for many negative effects. Mac Margolis painted an equally bleak picture in *Newsweek* (October 16, 2006): "A global temperature rise of a mere 0.6 degrees Celsius over the last century has sent shock waves through the animal kingdom. From the desiccating rain forests of Australia to the thawing Arctic, the warmer weather is expelling animals from age-old homelands, scrambling mating and nesting habits, and putting competitors on a prickly collision course. As habitable spaces get smaller, competition for food grows fierce. Meanwhile, insects and pests, which flourish in the heat, abound. So may the diseases they carry, like dengue fever, avian pox, or cholera. Scholars are asking whether the loss of individual species could have a knock-on effect all through the food chain. 'We are seeing problems from pole to pole; we see them in the oceans and we see them on land,' says Lara Hansen, chief climate-change scientist at the World Wildlife Fund. 'There are very few systems that I can think of that are untouched by climate change.'"

Activity *(for younger students)*

In discussing living creatures in danger, scientists use three terms in a very specific way: *extinct, endangered,* and *threatened*. Research the scientific meaning of these terms, and provide a one-sentence definition of each.

Activity *(for senior students)*

In Earth's history there have been five major, catastrophic extinctions where entire classes of life were wiped out. Some scientists believe that a sixth period of major extinction has begun, and that amphibians are one of the groups that may well disappear.

Prepare a short one- to two-page paper on the idea of the Sixth, or Holocene, Extinction. Include in your paper:

- Why some scientists believe this event is happening
- How long the event has been taking place
- Which major groups are facing extinction
- What the major causes are for the event
- Who or what will be the likely survivors
- Any other information you find especially relevant or interesting

There are many sources available describing the theory. Two excellent ones are an article by Elizabeth Kolbert entitled, "The Sixth Extinction?" *The New Yorker,* May 25, 2009, and a presentation by columnist David Cohen, "The Sixth Extinction," at the 2009 Association for the Study of Peak Oil & Gas International Peak Oil Conference. Kolbert's may be available through your school or public library. Cohen's is online at www.aspousa.org/index.php/2009/07/the-sixth-extinction/.

TRYING TO SAVE THE WORLD'S AMPHIBIANS

YV *Success Stories*

Further Research
Additional information on the El Valle Amphibian Conservation Center is available at www.houstonzoo.org/amphibians/.

The 2008 celebration of the Year of the Frog helped call attention to the plight of frogs around the world. It also drew attention to some of the ways in which scientists and others are working to help save amphibians. In this section we will look at some of those stories.

Pontifical Catholic University of Ecuador

The Zoology Museum at the Pontifical Catholic University of Ecuador is one of the leading amphibian research centres in South America. Ecuador is a country that has been losing large populations of frogs in recent years, and the museum has become one of the most important amphibian conservers in the world.

Scientists there are building a tissue bank they hope will serve a dual purpose: it will be a resource for the study of amphibian evolution and it may ultimately allow researchers to clone species that become extinct.

The museum is not only preserving dead specimens. It is soon to move to a new location, and researchers are planning to build a 14- to 20-hectare ecological reserve at their new home. The hope is that this reserve will be a home for endangered amphibians until they can be returned to the wild. The museum has already helped the city of Quito redesign one of its parks to make it "frog-friendly."

Part of the museum's program is to do research in the wild to locate new, unknown species of amphibians. The museum has at least 60 recently discovered species awaiting names. It also maintains a facility in which 16 or so extremely rare amphibians are kept alive in near-ideal conditions.

El Valle Amphibian Conservation Center

In an attempt to preserve several species of Panamanian frog, the Houston (Texas) Zoo and some of its partners created the El Valle Amphibian Conservation Center in El Valle de Anton, Panama. Because the chytrid fungus spread rapidly throughout Panama, scientists worked feverishly to collect living specimens long before the centre was ready to open. In fact, several hundred frogs spent a year in an El Valle hotel before they could settle in more permanent quarters. Edgardo Griffith, the centre's director, says that the hotel gave the animals a very good rate.

The centre opened to the public in April 2009. Its ultimate goal is to provide housing for 1 000 frogs representing 40 different species. Twenty-five males and 25 females of each species would provide a large enough population for breeding.

The centre's main priority is a breeding program for 17 of the most endangered species. Many of these species are little-known and have never been bred in captivity. The centre's activity in this area should add much to our knowledge of tropical amphibians. Someday, if the chytrid fungus is controlled, the centre's scientists hope to release these species back into the wild.

Toronto Zoo

Like zoos world-wide, the Toronto Zoo devotes considerable time and money to species conservation. In 1986 it began its breeding program for Puerto Rican crested toads, and by 2008 had released about 52 000 tadpoles into Puerto Rican ponds—an impressive statistic for an amphibian once believed extinct.

Further Research
You can learn more about the Toronto Zoo's crested toad program at www.torontozoo.com/AdoptAPond/pdfs/Puerto%20Rico%20crested%20toads.pdf.

Further Research
Learn more about chytrid fungus and Vance Vredenburg's research at web.me.com/vancevredenburg/Vances_site/Research.html.

In the summer of 2008 the zoo opened a frog rescue centre that is used to quarantine threatened species. According to Bob Johnson, the zoo's curator of reptiles and amphibians, the zoo intends to hold them "until the issue of the fungus can be removed from the wild, if it ever can, and then the animals can hopefully go back. There is a worldwide effort of scientists trying to fix the problems in the wild, and we're holding the animals here in trust so that they can go back hopefully in the near future."

One of the amphibians most treasured at the zoo is the Panamanian golden frog, a creature the zoo harbours in co-operation with the El Valle Amphibian Conservation Center.

The Fight against the Chytrid Fungus

Some scientists are also reporting success in fighting the chytrid fungus. Vance Vredenburg, a biologist at San Francisco State University, studies frogs at the Sixty Lake Basin in California's Sierra Nevada. Almost all of the frogs he was studying were killed by chytrid. But as he saw the frogs dying, Vredenburg removed some of the adults, treated them with an antifungal medication, and returned them to their pond. The population has remained stable for three years. Another group of conservationists, based in the United Kingdom, has announced plans to attempt a similar treatment with a threatened Spanish species, the Mallorcan midwife toad.

Other researchers have discovered a symbiotic skin bacterium on red-backed salamanders and some frogs that actually inhibits the growth of the chytrid fungus. Reid Harris of James Madison University says: "If we can augment the good bacteria to help lower transmission, there may be time for the animals to ramp up their own immunity. And we wouldn't be putting anything into the environment that isn't already there. Perhaps we can stop the epidemic outbreaks of chytrid" (*National Geographic,* April 2009).

For Your Consideration

Are you interested in helping to preserve the world's amphibians? One way in which you can help is by supporting the efforts of Amphibian Ark (see the Case Study: Amphibian Ark section on page 53 of this guide for more information on their goals and activities).

Amphibian Ark's Web site has a collection of entries showing the many ways in which students and other groups and individuals have provided them with help in the past (www.amphibianark.org/howyouhavehelped.htm). Perhaps you and/or your class would like to consider an activity to help raise funds to donate to this cause.

TRYING TO SAVE THE WORLD'S AMPHIBIANS

YV *Case Study: Amphibian Ark*

Further Research
Amphibian Ark's Web site is www.amphibianark.org.

In 2005, the World Conservation Union put together an Amphibian Conservation Action Plan (www.amphibians.org/ASG/Publications_files/ACAP_1.pdf) to guide conservation organizations in their attempts to preserve the world's threatened amphibians.

Amphibian Ark was the organization founded to address the recommendations in the plan. It is sponsored by two committees from the World Conservation Union: the Conservation Breeding Specialist Group and the Amphibian Specialist Group. The third sponsorship partner is WAZA, the World Association of Zoos and Aquariums.

The goal of Amphibian Ark is to help keep the world's amphibians safe in nature. It defines its mission as "ensuring the global survival of amphibians, focusing on those that cannot be safeguarded in nature."

Ensuring Survival

Amphibian Ark is very clear on how it feels the problem of ensuring amphibian survival should be addressed. It does not want to see animals collected from the wild only for exhibit in zoos in wealthy countries. It does want to see facilities developed in the animals' countries of origin where they can be cared for and conserved.

Rescuing a threatened species may at first involve sending it to a facility in another part of the world. But Amphibian Ark's ultimate goal is to see every country of origin responsible for the survival of its own species.

To ensure the program's success, Amphibian Ark provides facilities and training to assist scientists and researchers to meet this goal. Amphibian Ark will help local conservationists identify and prioritize local species most in need of preservation efforts. It helps identify local individuals, organizations, and agencies that can help in preservation activities. It provides resources and expertise to begin the preservation process.

Typical of this approach is the Houston (Texas) Zoo's assistance to Panamanian scientist in developing the El Valle Amphibian Conservation Center. The zoo has contributed more than USD$200 000 to the construction of the centre. Along with other zoos, it has assisted Panamanian researchers in the capture of specimens. It has provided training and advice on the care of those specimens. But overall responsibility remains in the hands of the Panamanian scientists and other staff.

Conservation Breeding

One area of special emphasis for Amphibian Ark is the promotion of conservation breeding. It provides its partners and interested individuals with the most up-to-date research on successful methods of captive amphibian breeding.

Amphibian Ark recognizes that more places than just zoos and aquariums are breeding amphibians. Private individuals keep them and breed them as pets. Commercial operations breed them for sale for educational and research purposes, or for consumption. Amphibian Ark hopes to draw on all this expertise, while at the same time promoting high ethical standards among all these groups.

Future Prospects

Amphibian Ark's goal is an ambitious one. It hopes to have 500 members of

each of 500 different species in protected habitats within the next several years. It is also working hard to prevent one of the biggest potential problems with captive breeding programs: inbreeding. Program director Kevin Zippel has high expectations (*Nature*, March 27, 2008): "We are aiming to maintain 90 per cent of the genetic diversity of the group over 100 years."

Other specialists, however, believe that Amphibian Ark may be creating expectations that can't be met. If environmental degradation increases, if global warming continues unabated, and if chytrid continues uncontrolled in the wild then most of the rescued species will never be able to be released from captivity.

Ecologist Alan Pounds sums up the doubts of the skeptics with an interesting analogy (*Nature*, March 27, 2008): "I would say that under such circumstances captive breeding programs can save amphibian diversity in about the same sense that a museum of Incan art can save Incan culture."

It would indeed be sad if hundreds of species of amphibians, some of the oldest animals on the planet, survived only as isolated specimens in glass cages in zoos, aquariums, and conservation centres. But as long as there is hope that they can someday be returned to the wild, researchers will be doing their best to ensure the survival of as many species as possible.

Most of the scientists involved in amphibian research would echo the opinion of Jeffrey Bonner, president of the St. Louis Zoo: "It is absolutely our obligation" (*Nature*, March 27, 2008).

For Discussion

1. If it were up to you, how would you prioritize the collection of amphibians for preservation? Would you choose the rarest specimens first? Those most susceptible to a particular threat, like disease? Those that you would most likely be able to reintroduce to the wild once relatively straightforward environmental corrections were made?

2. Does Alan Pounds' argument—that saving most amphibian species only means that they will become objects in a museum—carry any weight with you? Is it really an argument against Amphibian Ark's rescue program?

TRYING TO SAVE THE WORLD'S AMPHIBIANS

YV *Activity: Should Frogs Be Dissected in School?*

For years the dissection of frogs has been one of the basic activities of school biology classes. Abundant, inexpensive, and very similar in basic anatomy to humans, they are considered to be an excellent way to introduce students to the inner workings of the animal kingdom.

In recent years, however, many people—for a variety of reasons ranging from animal rights to declining amphibian populations to squeamishness—have objected to frog dissection in schools. Many point to the availability of "virtual frog" dissection kits as a reason that actual dissection of living frogs is no longer necessary.

The following resolution is offered for debate:

"Be it resolved that the dissection of real frogs be banned at this school."

Teams for the affirmative and negative should consist of two students each. Each team would have three minutes for its opening argument and one minute for a rebuttal of its opponents' arguments.

As you might expect, there is considerable information readily available on the Web supporting this resolution and against frog dissection. See, for example, "Frogs are cool!" at www.frogsarecool.com/dissection.htm; or, "Does classroom dissection deplete species, encourage cruelty to animals?" at http://environment.about.com/od/biodiversityconservation/a/dissection.htm.

Pro dissection material is somewhat harder to come by. However, two articles worth reading are Newton BBS Ask a Scientist: "Why dissection?" at www.newton.dep.anl.gov/askasci/gen06/gen06348.htm; and Keith Wilhelmi's "Self-paced frog dissection guide" at http://frogdissectionlab.com/why_frog_dissection.html.

Note: Both sides will likely find it wise to consult one or more science teachers in the school for their opinion on the subject.