

Imagine a silent pond. No croaks, no peeps, no “ribbits,” no noisy frogs. If the number of amphibians like frogs continues to decline, you will not need to use your imagination. All ponds will be silent. Biologists have recently become aware of the gradual disappearance of frogs, toads, and salamanders, which seem to be dying at unprecedented rates. About 30% of North America’s frogs and toads are in trouble.

Amphibians have been around for more than 400 million years. When most animals and plants died out about 250 million years ago, amphibians survived. Frogs skipped right by the catastrophe that killed all the dinosaurs 65 million years ago. Frogs and their relative have adapted to ice ages and extended periods of global warming without missing a beat. These timid amphibians can withstand drought, flood, and winter ice. They can be found in most ecosystems that include water. (**Ecosystem** is a term used to describe the relationships among the many species living in an environment and the relationships among those organism and the non-living components of the environment.) Amphibians live on the peaks of the Canadian Rockies, in the city parks of Toronto, and in the swamps of Newfoundland. They have even done well dealing with the growth of the human population - at least until recently.

### WHY ARE SCIENTISTS CONCERNED?

Other than those who enjoy eating frogs’ legs, why would scientists care about amphibians? Many believe that the health of amphibians indicates the health of the ecosystems they live in.



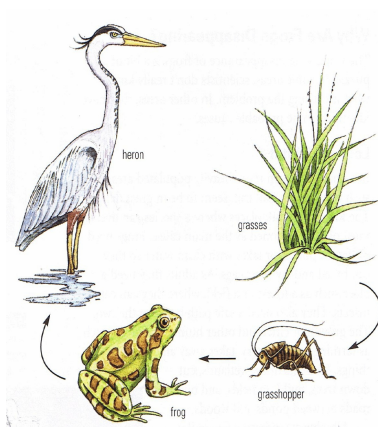
The word amphibian is a clue as to why frogs and toads can be used to diagnose the health of ecosystems. The word comes from two Greek words, *amphi* (“on both sides”) and *bios* (“life”). Amphibians literally have two lives. Frogs begin as eggs and grow to tadpoles in ponds, and then enter their second life as adults in forest and grassland areas. This means they are exposed to hazards in both ecosystems, instead of only one. Any decline in the health of either of the two ecosystems in which they live will have an impact on frogs.

Not only do frogs occupy two different ecosystems, they are also parts of two very different food chains. A **food chain** is a step-by-step sequence linking organisms that feed on each other, starting with a food source such as plants (**producers**), and continuing with animals and other living things that feed on the plants and on each other (**consumers**).

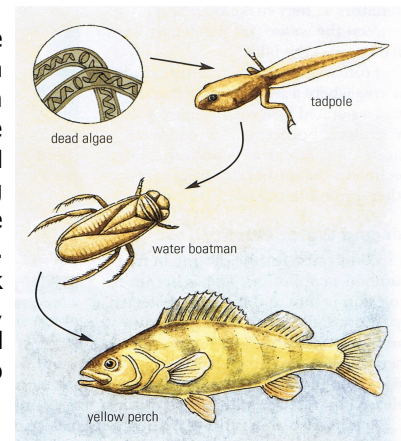
### FROGS IN THEIR ECOSYSTEMS

Adult frogs eat mostly insects, although they may also eat some small fish. In turn, large fish, predatory birds, reptiles, and small mammals eat frogs. This makes the adult frog a member of a food chain that includes producers (plants), **herbivores** (animals that eat plants) and **carnivores** (animals, like the frog, that feed on other animals). Animals that eat both plants and animals, such as humans, raccoons, and bears, are called **omnivores**.

If frogs were completely wiped out, insect populations would most certainly soar. This has already happened in Bangladesh, where frog populations have been decimated to supply restaurants with delicacies. The result was an increase in the number of mosquitoes, and a dramatic increase in cases of malaria among humans. Malaria is a disease that is transmitted by mosquitoes, which are eaten by frogs. The increase in malaria can be traced back to the disappearance of frogs from the local ecosystems.



Tadpoles eat large amount of algae (small plant-like organisms), both living and dead. The tadpole is a herbivore, not a carnivore, and is part of a much different food chain. In this food chain there are two food sources – producers (the algae) and **detritus** (waste from plants and animals, including their dead remains). Detritus food chains are critical in the recycling of matter in ecosystems. They include **decomposers**, organisms that break down detritus to get nutrients for their own use, but in the process also release nutrients to the soil and water. Plants and algae use those nutrients to grow.



## WHY ARE FROGS DISAPPEARING?

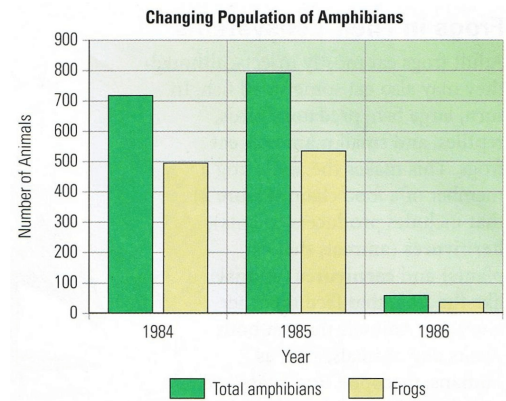
The worldwide disappearance of frogs is a bit of a puzzle. In some areas, scientists don't really know what is causing the problem. In other areas, they have identified some probably causes.

### LOSS OF HABITAT

In Canada, frogs in more heavily populated areas, such as southern Ontario, seem to be in great danger. The loss of habitat, places where a species can live, is most often mentioned as the main cause. Frogs need wetlands, ponds, or lakes with clean water so they can breed and lay their eggs. As adults they need a place such as a forest or a field, where they can catch insects. They also need a safe path between the two. The growth of cities and other human activities, such as farming and industry, takes away all of these things. Humans drain wetlands, cut down trees, build on fields, and build roads between ponds and woods.

A highway separating a woodlot from a pond or lake can claim the lives of many frogs as they move between their feeding and breeding areas. Cutting down some of the trees that surround a lake creates problems for amphibians by exposing them to predators as they make their way between the water and the denser trees farther from the lake.

From 1984 to 1986 scientists studied an area where a swamp and a forest were separated by a road. When trees bordering the road were cut in 1986, researchers noticed a huge decline in the number of frogs and other amphibians.



### AIR AND WATER QUALITY

A second cause for the decline in frog numbers is pollution. This is because frog skin is thin and it is not protected by feathers, fur, or scales. Frogs have lungs, but they also breathe through their skin, which must be thin to allow oxygen through. Pollutants can also pass through their thin, moist skin. Acid rain, caused mostly by pollutants released by vehicles and industry, is just one example.

Acidity also affects frogs' ability to reproduce. Researchers have noted that if the water is even slightly acidic, it reduces the mobility of frog sperm cells. This makes it less likely that eggs will be fertilized. Even if mating is successful, acid affects the frog's development. Embryos, if they develop at all, grow slowly in acidic water. In some locations, this means that the pond they are in will dry up before tadpoles can become adult frogs, and the tadpoles die. Acidic water can cause other problems. For example, embryos may develop deformed limbs. Tadpoles with such limbs do not survive for very long.

### ULTRAVIOLET RADIATION

The thin skin of the frog is also susceptible to ultraviolet (UV) radiation. This invisible radiation from the Sun causes sunburns, but it has also been linked with more serious cell damage. The amount of UV radiation reaching the Earth's surface is increasing because of damage to the protective ozone layer surrounding our planet.

Frogs at higher altitudes, where the problem of UV is greater, seem to be the ones that are most endangered. Many highland species are used to dealing with UV radiation (they lay black eggs and have developed a black covering that lines their internal organs for protection), but biologists speculate that the adaptations can not keep pace with changes in the ozone layer.

The frog is not the only animal whose skin is exposed to UV radiation. Humans also have a delicate skin and are affected by the increase in UV rays. The fact that the rate of human skin cancer is rising all over the world underscores the importance of studying the frogs as a "bioindicator" of the health of the planet.

### CLIMATE CHANGE

Human activities that are causing a change in climate have also been linked to the disappearance of frogs. There is evidence of a global warming trend. One hypothesis links increasing global temperatures with the increased use of fossil fuels such as coal, oil, and gasoline. Climate changes can cause important changes in local ecosystems. For example, if the climate becomes drier, frogs will suffer. No frog can stay in the sun too long or completely separate itself from fresh water.

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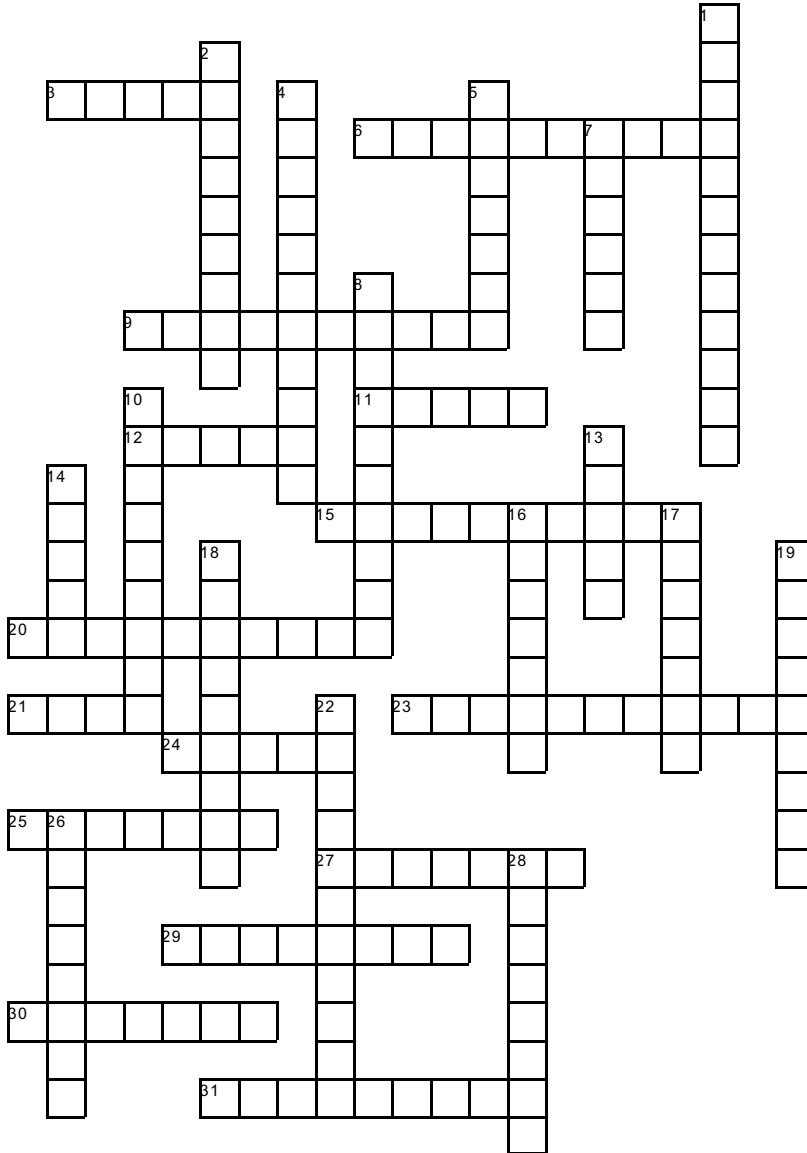
## PRACTICE

Answer the following questions on a separate piece of paper. Be sure to use full sentences when required!

1. Explain the difference between the two food chains to which the frog belongs. Explain the role of the frog in each chain.
2. According to the scientists, what are some of the probable causes behind the disappearance of the frog?
3. Explain why the life cycle and skin of the frog make it a good "bioindicator" of the health of an ecosystem?
4. Make a list of things that humans could do, or avoid doing, that might help frogs to survive. Which ones would be easy for us? Which ones would be difficult?

## INSTRUCTIONS:

- ① Read the handout "The Silence of the Frogs"
- ② Complete each statement by finding the word that fits in the space. The number in the bracket indicates the starting space. The letter represents (a)cross or (d)own.
- ③ Answer the practice questions (see handout) on the back.



1. Frogs can be found in most ecosystems that include (3a). They've been around for more than 400 million years, and even survived the disaster that killed off the (19d). Unfortunately, scientists have noticed that frogs and other amphibians are disappearing rapidly - mainly by the growth of the (14d) population
2. Why is this a problem? Many scientists believe that frogs are (20a) of the health of the ecosystems they live in. Frogs have two lives. They begin as eggs and grow to (29a) in ponds, and then enter the second stage of their life as adults in forest and (18d) areas. This means that problems in either of these ecosystems will have an impact on the frogs.
3. Frogs are also part of two very different (8d). A food chain is a step-by-step sequence linking organisms that feed on each other, starting with plants ((2d)) and continuing with animals and other living things that feed on the plants and on each other ((31a)).
4. As a tadpole, frogs are plant eaters ((9a)) - they eat both living and dead (24a) (a plant-like organism). This type of food chain includes organisms that break down the waste from living and dead organisms to get nutrients for their own use ((22d)). As they break down the wastes, the nutrients also become available for plants and algae. Adult frogs are meat eaters ((6a)) - they feed on other animals. Their main diet is (5d), but they may also eat small fish.
5. If frogs were completely wiped out, insect populations would certainly (28d). This has already happened in (15a), east of India, where frog populations have been nearly eliminated to supply (23a) with delicacies. The result is a rise in the number of mosquitoes, and thus a rise in (27a) (a disease transmitted by mosquitoes) among humans.
6. The most important cause for the decline in frog populations is the lack of an appropriate place to live ((17d)). Frogs need wetlands, ponds, or lakes with clean water that they can (13d) and lay their eggs. As adults they need a place such as a forest or a field where they can catch insects. Human activities such as (30a), forestry, road (1d), and the growth of towns and cities take away valuable habitat from the frogs.
7. A second cause is (10d). Frogs have lungs, but they also absorb (7d) through their skin. Since their skin is so thin, it is easy for pollutants to pass through. (26d) is the most common pollution problem. An increase in the (16d) of the water causes reproductive and growth problems for tadpoles.
8. A third cause is (4d) (UV) radiation from the Sun. The amount of radiation reaching the Earth's surface is increasing because of the damage to the protective (12a) layer. As a result, the thin (21a) of the frog makes it vulnerable.
9. A fourth cause is human activities, such as those that use fossil fuels, contribute to global (25a) which in turn causes climate changes. Frogs are affected by climate changes in local ecosystems. For example, if the climate becomes (11a), frogs will likely lose some of their wetland habitat.