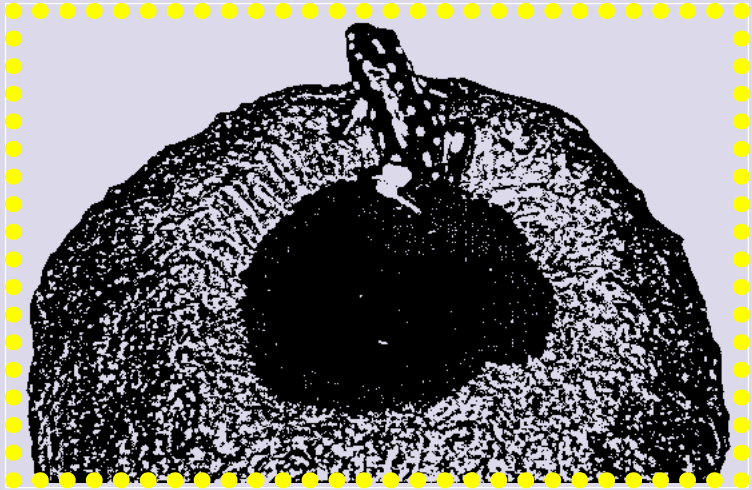

JANALEE CALDWELL

Rainforest Ecologist

by Mary Knudson



Women in Science Learning Series

Rainforest Ecologist: Janalee Caldwell Biography

SCIENCE CAN BE FOR YOU.

This series of learning kits introduces you to women who have made science their career. The kits are produced by the University of Nebraska State Museum in Lincoln, Nebraska. The entire series has been funded by the Howard Hughes Medical Institute.

Project production is directed by Judy Diamond with the collaboration of Peter B. Tirrell and his staff at the Oklahoma Museum of Natural History, Gary Hochman, Michael Winkle and Bruce Thiel of Nebraska Educational Telecommunications, Linda Allison, Suzanne M. Gardner, Rayna Collins, Beth Schenker, Amy Spiegel, and Mary Knudson. We wish to give special thanks to Mark St. John, Roger Bruning, Marian Langan, Dana Esbensen, Rosemary Thornton, Edith Meints and Monica Norby. Most of all we wish to express our gratitude to Janalee Caldwell for the many hours she contributed to this project.

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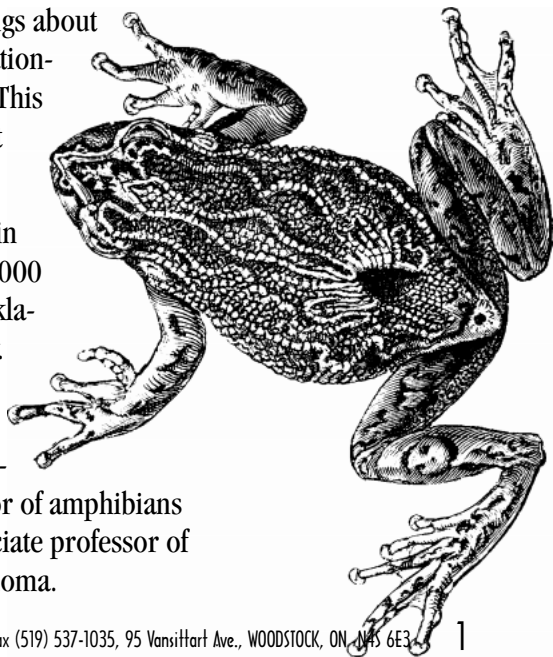
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For four months every year, biologist Janalee Caldwell leaves the comfort of her beautiful country stone home in Oklahoma to live in a makeshift lean-to fashioned from trees and plastic deep in the rainforests of the Amazon Basin in South America. She and her biologist husband, Laurie Vitt, trek into isolated areas of unexplored forests to find out what kinds of frogs and reptiles live there. Janalee is interested in frogs. Her husband does research on lizards and snakes.

To do her research, Janalee spends many hours each day standing in the forest observing frogs and tadpoles through binoculars. She takes notes or talks into a tape recorder to have a record of what she sees and hears. She frequently goes out at night, walking kilometres into the forest with a headlight strapped to her forehead, because some animals she and her husband want to find only come out at night.

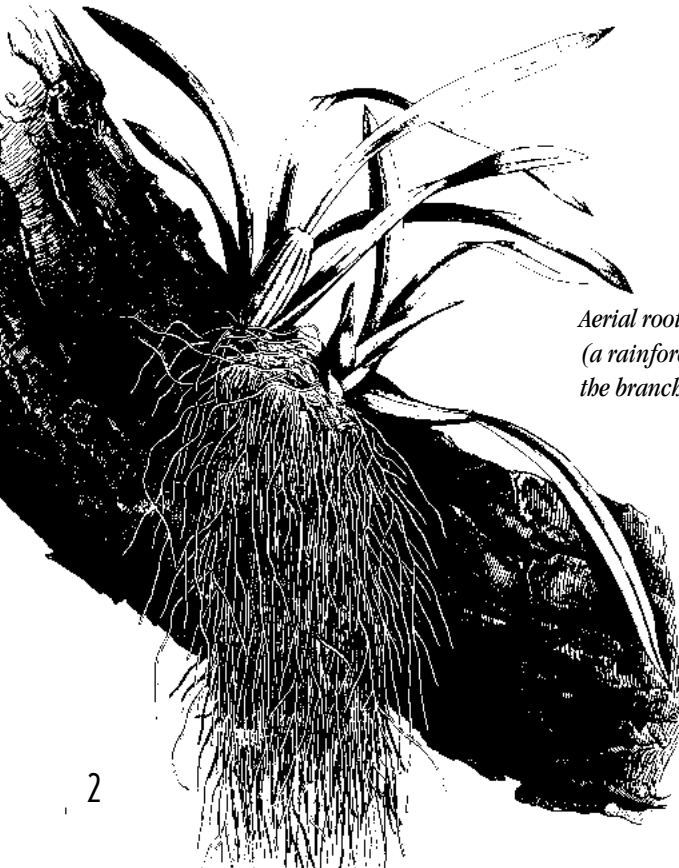
Janalee collects samples of the forest's frog population, photographs them, and kills them quickly in a solution. Then she removes their stomachs with tiny surgical instruments so that she can examine the stomach contents to find out what prey the frog has eaten. Janalee preserves the frogs so that they can be seen in museums and borrowed for study by people all over the world. She also writes articles for scientific journals on her new findings about the behavior of frogs and the relationships between frogs and insects. This helps scientists know more about the ecology of rainforests.

Together, Janalee and Laurie are in charge of a collection of over 35,000 amphibians and reptiles at the Oklahoma Museum of Natural History. Amphibians such as frogs are animals that can live both on land and in water. Janalee is associate curator and Laurie is curator of amphibians and reptiles. Janalee is also associate professor of zoology at the University of Oklahoma.



Janalee and Laurie were already married when they were fortunate enough to get their jobs together at the museum. Many couples who are both scientists find it hard to get interesting jobs in the same location. Michael Mares, director of the museum and a professor of biology, was very supportive of bringing Janalee to her positions in Oklahoma, and says she is very dedicated to what she does and has very high standards for the university students she teaches.

Janalee finds her research in the rainforests fascinating, even though she has to put up with many inconveniences and knows that she could face real danger. She and Laurie often go their separate ways in the forest. One



*Aerial roots of an orchid
(a rainforest plant) on
the branch of a tree.*

day Janalee was working by herself, kneeling beside a huge fallen tree that had a hole filled with rainwater in which tadpoles were living, when she heard a crackling sound. “I kept hearing this shotgun sound, like a popping sound,” she said. “I thought it must be seeds. There are some seeds that make a popping sound when they pop open. I didn’t think too much about it and kept working. It kept getting a little bit louder and also the sounds were closer and closer together.”

Janalee decided to try to look for what was causing the noise. She got up on top of the fallen tree she had been working on, which put her about 3 m above the ground. Just at that moment, the tree next to the one she was standing on started to fall. “I could barely breathe, it scared me so bad,” she remembers vividly. “I jumped off the tree, this big buttress that I was standing on, and tried to go under it because there was a big space under it, just to get away from the tree that was falling, because I really didn’t know which way it was going to fall. At that point I could see it snapping. It’s a horrible kind of sickening sound.”

The tree crashed to the ground parallel to the one Janalee was hiding under, missing her by a few centimetres. That was her closest brush with a falling tree, a common hazard in the rainforest. “I would say that every day that you’re out there you hear in the distance one or more trees falling,” she said. “Rainforest trees grow very tall and the roots which anchor a tree to the ground do not grow deep, but spread out. So, trees get top-heavy,” Janalee explains, “and, especially after a rain, they are at risk of falling.”

But inconveniences are more common than danger for those who dare to work in the rainforest. With no nearby supermarket to run to, Janalee and Laurie settle for eating beans and rice every day. The bathroom is simply the great outdoors. The biologists hire some local workers to build a lean-to from small trees. The roof is made of palm fronds that are covered with black plastic to keep the rain out. Janalee and Laurie eat and sleep inside the lean-to, and use one section of it for a laboratory. They sleep in hammocks that Janalee says are really comfortable.

Janalee likes snakes as much as her husband does. The one thing she is really afraid of is spiders. On her last trip to a Brazilian rainforest, she could look up from her hammock and see several large, mildly poisonous spiders called tarantulas lurking overhead in the corners of the makeshift ceiling. Neither she nor Laurie would ever kill the spiders or other creatures that sometimes invade their living quarters unless it was a research subject they wanted to study and preserve. They feel that killing any other insect or animal would be unethical because the rainforest is the natural home or habitat for the spiders, insects and animals that live there. Janalee and Laurie consider themselves to be the intruders. But Janalee sometimes calls on Laurie to remove the spiders and put them outdoors.

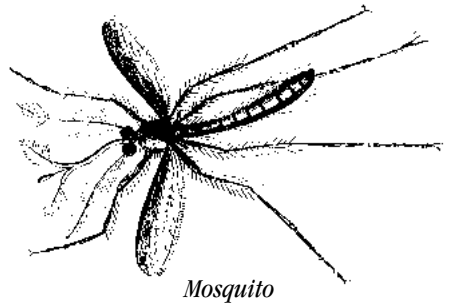
Laurie finds Janalee's reaction to spiders really funny because it is so different from the usual independence and courage she demonstrates while working. Typically, Janalee works alone in the rainforest and back at camp is relaxed and easy to be with, Laurie said. But one



Janalee and a bushmaster snake (Lachesis muta)

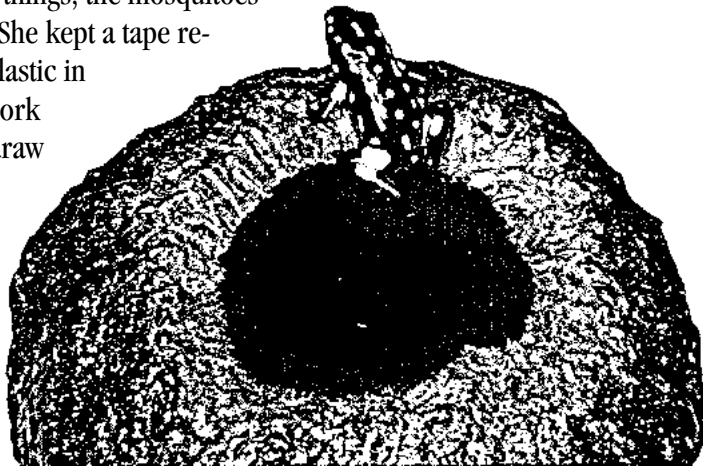
Photograph courtesy of Dr. Laurie J. Vitt.

morning when she was getting dressed, she picked up a shirt that she was going to put on and there was a big tarantula that had moved into it. “She threw the shirt about 6 m out into the mud,” he said, laughing.



Mosquitoes usually are not a bad problem in the tropics because there are so many different kinds of insects that things are sort of in balance, Janalee explains. But on her last trip, she said, for some reason, the mosquitoes were just awful. Throughout the day and night, week after week, a horde of mosquitoes hovered around her, buzzing in her ears. “I had to put on repellent every twenty minutes all day long for three months,” she said. “Laurie and I together used 14 bottles of repellent. And any time you stopped, they’d start landing on you and they could bite through your clothes.”

Once, when Janalee was standing behind a tree, trying to observe some very interesting behavior between a mother and father frog and their tadpole, the mosquitoes made her work especially challenging. “You don’t want to move much because that scares the frogs,” she said. “So I’d have the repellent in my pocket and I’d have to just barely move my arm so that the frog didn’t notice. Get my repellent out, slowly put it on, just try not to move. When the frogs would be doing the most interesting things, the mosquitoes would start biting.” She kept a tape recorder covered in plastic in one pocket of her work clothes and would draw it out and describe what the frogs were doing and put it back in her pocket.



*Poison frog on
the rim of a
Brazil nut pod.*

Image courtesy of Dr. Janalee P. Caldwell.

Janalee goes out to observe in the forest no matter what the weather is like. "One time we watched these frogs for three hours in a driving rain-storm," she said. "If you want to know what's happening," she says, "you've got to be out there."

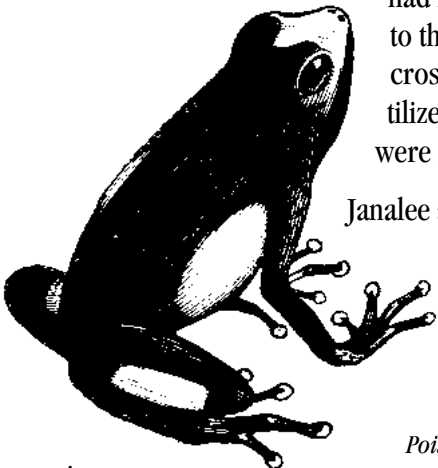
Janalee has learned a lot about some poisonous frogs that have shiny black bodies and bright yellow spots. She found that each frog had a different spot pattern, so she could identify each one through her binoculars. She stands about 3 m away from the frogs to observe them.

"It was fascinating," she said, "because these frogs remained true to their mate, which is very uncharacteristic of frogs. The same male and female stayed together and they raised their tadpoles in little tiny tree holes and little holes that are in vines that go through the tropical forest. The tree and vine holes collect rainwater. A male frog would carry his tadpole on his back to one of the holes and put the tadpole in the hole. Then the male frog would lead the female frog to the hole by calling to her. The mother and father go into the hole for about three hours. They go through the entire courtship ritual in the hole," Janalee says. Then the female lays what is called a nutritive egg. It's not an egg that's going to be fertilized. It's an egg that they put in there for the tadpole to eat.

Janalee identified many pairs of frogs and would go check on them every day. After the parents left, she would stick a long thin laboratory instrument, called a pipette, into the hole and suck up the eggs that the tadpole

had not eaten. "I could then take these back to the laboratory, study them under the microscope and find out whether they were fertilized or not," she said. All but two eggs were not fertilized.

Janalee and Laurie have been going to the Amazon regions of South America since 1985. They used to go every other year, but since 1991 they have gone every



Poison frog

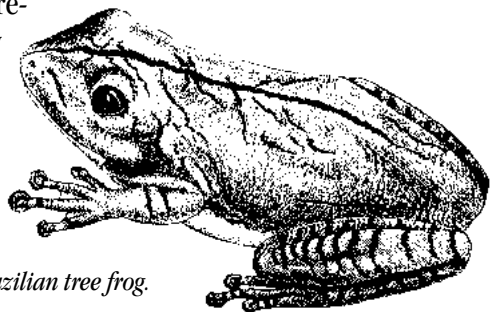
year, usually to Brazil. “There’s a tremendous amount that we don’t know about reptiles and amphibians in the Amazon Basin,” Janalee says. “So little of it has been explored. At the most basic level, we don’t even know what occurs there. So, part of our goal in going in there is to collect as many individuals of as many species as we can. We take up to 50 of a species. We need that many for study because there is so much individual variation that you have to have a large sample size.”

One thing Janalee is interested in is what frogs eat. She recently wrote an article for the *Journal of Zoology* in London on the diet of poisonous frogs she had studied in the rainforest. The article was based on almost 13,000 prey items taken out of 212 frogs. “If I don’t have a sample of at least 50 individuals, I can not determine what the diet is,” she explained.

Janalee is very skilled in the study of insects and finds it easy to identify insects inside a frog’s stomach because a frog swallows its prey whole. “So everything in the stomach is in almost perfect condition,” she says, “especially when the frog is preserved almost immediately.” Some stomachs are so tiny that they look like a dot in the vial where they are preserved, so Janalee studies the prey under a microscope. A stomach 1–2 mm long may contain more than 30 prey items, tiny things like mites. A stomach this size is in an adult frog that is only 2 cm—about the size of a large black ant. Adult frogs range in size from 1 cm long to about 30 cm long.

So far Janalee and Laurie have visited six different states in Brazil, collecting frogs and reptiles in areas where no other scientists had been before. They have a grant from the National Science Foundation to fund their research trips until 1999. Then they expect to apply for another grant to continue their work.

Often they are working in a forest just before it is torn



Brazilian tree frog.

down. The owners cut down the timber to sell it and turn the area into a grazing ground for cattle or fields for crops or other uses. Janalee says she wishes people who care about animals would focus more time and attention on saving habitats such as rainforests and deserts. When these habitats are ruined to make way for cattle grazing or for more people moving to live there, the animals and plants that lived there die, and some species may become extinct. "There's a tremendous amount of tropical forest destruction going on, and a lot of the areas we've been in have been destroyed now," Janalee says. "As a result the spotted poison frogs that I followed day after day and studied intensively, along with all the other kinds of frogs that lived in the rainforest are now dead," she said. "They couldn't possibly exist without the forest."

That's why she doesn't feel badly about killing 40 or 50 frogs of each kind on her research trip, Janalee said. Those are the only frogs that remain now from that area, preserved in the Oklahoma Museum of Natural History and in a museum in Brazil, because all the rest have been killed. And there were thousands and thousands of frogs there.

Janalee found that one important way frogs make use of the rainforest is by rearing their tadpoles in Brazil nut capsules that have fallen to the ground. The capsules are wooden shells about the size of a grapefruit. A

Agouti

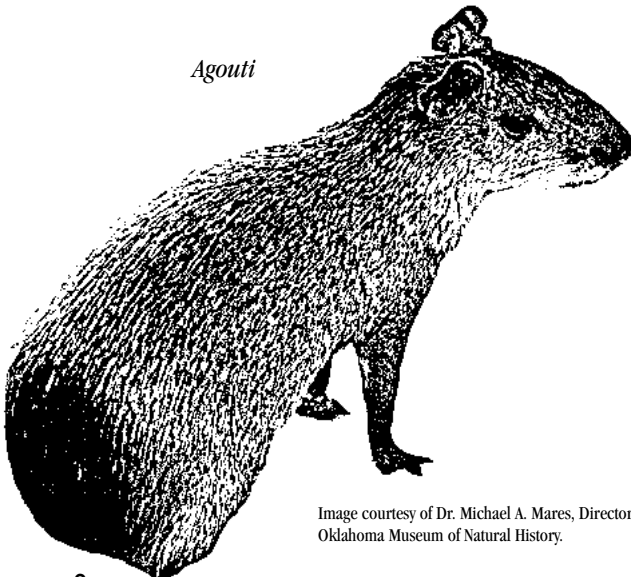


Image courtesy of Dr. Michael A. Mares, Director & Curator of Mammalogy, Oklahoma Museum of Natural History.

rodent called an agouti (pronounced *ab GOO tee*) cracks open the husk, removes the Brazil nut seeds, and discards the capsule. The capsule collects rainwater, and frogs and some insects find it just right for breeding babies.

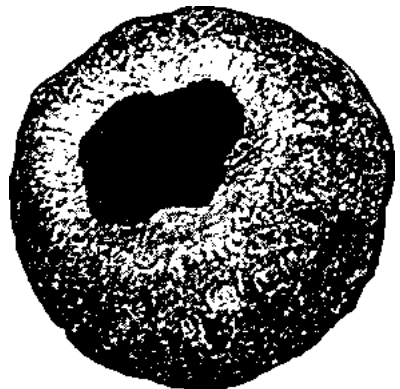
To study this behavior, Janalee first collected the contents of capsules she found on the forest floor. Then she filled 40 nut capsules with new rainwater and laid them out in a grid in the forest. She checked them all every other day to find out what kinds of tadpoles and insects were put there and how well they survived. She found that two species of insects lay their eggs in the capsules.

“Insects that hatch out will eat small tadpoles that share the capsule, and poison frog tadpoles will eat tiny insects,” she said.

When Janalee, the scientific observer, began watching frogs and frog eggs, she sometimes had a feeling of *deja vu*. When she was a little girl growing up in Miami, a small town of about 12,000 people in northeastern Oklahoma, some neighbors had a pond in their yard.

“I remember being really fascinated with the frogs in their pond, especially the frog eggs,” she said. “In the early spring when frogs would start laying their eggs I would just want to lie there and get my face down as close as I could to the eggs and watch those eggs.” She would watch a frog start as a tiny embryo with a bit of yolk inside a clear capsule, and then become a tadpole that breaks out of the capsule.

Janalee was the only child in her family, one reason she may have found a lot of time to spend with animals. She often put toad eggs into her aquarium so that she could watch them hatch into tadpoles. Once her father brought her a newt, a kind of salamander, and they put it in the aquarium, too. Then the tadpoles gradually started disap-



Open Brazil nut pod.

Brazil nut pod image courtesy of Bruce Thiel.



Janalee Caldwell

pearing because the newt was eating the tadpoles, she said.

“Now I still work on predation on tadpoles. So you have to wonder if it didn’t start way back then. I think there is a certain element of genetics involved. It seems that if you’re really interested and fascinated with those kinds of things when you’re very young, you just can’t get over that fascination.”

When she was growing up in Oklahoma, women were not expected to have careers, Janalee said. Her mother stayed home while she was young and later helped her father run his several small businesses. “I wasn’t really encouraged along the way at all. It was just sort of myself finding my own way,” she said. Her grandmother on her mother’s side was a Cherokee, and Janalee is a registered member of the Cherokee tribe. She says many people who grow up in Oklahoma are part Native American.

She describes herself as shy in high school, although the football team voted her homecoming queen her senior year. She took all the science courses that were available in high school. A few years ago her Aunt Burniece told her, “I remember you always wanted to study everything and learn everything. I was never like that.”

During her high school years Janalee thought she would become a veterinarian. But in college she realized she could specialize in doing research on frogs if she went on to graduate school. After college she got advanced degrees, including a Ph.D. from the University of Kansas.

Wanting to broaden her experience, Janalee decided to try administrative work for awhile, and took a job as Assistant Dean of the Graduate School at Emory University. She was responsible for overseeing admissions and keeping statistics on programs and services for graduate students, and overseeing a million dollar budget. She felt she learned a lot working with the woman who was the dean at the time, and has remained friends with

her. But Janalee decided that administrative work was not what she wanted to do.

It was during that time that she met Laurie. She went to a meeting at Arizona State University where Laurie, then a graduate student, was leading a tour of the desert. “He looked great!” she remembers. “He had on jeans but no shirt, and he had long, blond hair.”

Their paths crossed a couple of more times, and when Laurie took a research job at a lab in Georgia, he began visiting Janalee in Atlanta. They’ve been married 10 years and lived and worked in California for a few years before coming to Oklahoma in 1990. “We’re always together,” Janalee said, “and we just enjoy working. We work all the time.” They frequently help one another with their work. Laurie often reviews Janalee’s papers and advises on data analyses, and she often critiques his papers that will appear in journals.

Janalee and Laurie live in a lovely stone house that looks out on a one hectare pond, home to seven species of frogs. When the real estate agent showed them the property that includes several hectares of forest, they couldn’t contain their delight. They ran over to the pond, quickly found a snake and some frogs, and said, “We love it. We’ll take it.” Then they told the stunned realtor they really should see the house first. They loved the house, too.

Eventually, Janalee says, she and Laurie, who are now in their early fifties, will likely give up biology for a more relaxing life. She could enjoy being a bead artist. Laurie would be a stained glass artist. Laurie used to play saxophone and guitar in a rock band, something he might like to do again. “And we both could probably spend full time doing projects around the house and gardening,” Janalee said.

But not for some time yet. Now they work seven days a week and never get caught up. Janalee has articles to review for several journals for which she is an editor, papers of her own to write, and so much data to analyze from the last trip. And there will be many more field trips to the rainforests, and lots more data, and many more papers to write about the frogs who make their home in the tropics of South America.

GLOSSARY

Amphibians—A class of vertebrates (animals with backbones) that includes frogs, toads and salamanders. They are capable of living on land and in the water.

Biologist—A scientist who studies living things, including what they are, how they function, and how they interact with other living organisms.

Curator—A person who is in charge of all or part of a museum collection.

Deja vu—A feeling of having experienced something before.

Ecology—The interrelationship among all animals and plants and their environment in a particular geographical area.

Extinct—When no member of a species or group of animals is living, that species or group is extinct. For example, dinosaurs are extinct.

Fertilized—The union of reproductive cells from a male and a female to form a new life.

Habitat—The natural environment or home of an animal or plant.

Herpetology—The branch of zoology that deals with the study of amphibians and reptiles.

Nutritive—Used as food to stay alive and to promote growth.

Pipette—A long, slim tube, with measurements marked on the sides, that scientists use to transfer precise amounts of liquid from one place to another.

Prey—An animal, taken while alive, by another animal as food.

Rainforest—A large tropical area dominated by trees that has a high yearly rainfall—at least 250 cm. The broad-leafed trees form a canopy over the rainforest, which is a habitat for many kinds of animals and plants.

Species—A group of animals or plants with common features that is known by a common name. A species is a division of a larger class called a genus.

Tadpole—The larval stage of an amphibian, an animal that can live on land and water. It has a round body and long tail.

Tarantula—A large, hairy spider that is mildly poisonous to humans. Its reputation is worse than its bite.

Zoology—The study of animals.