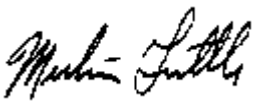
BCI'S Exciting New Educational Package!

Discover Bats! **is inspired by the countless inquisitive children and enthusiastic educators who have shared their questions and ideas with me over the past 30 years. Bats lived long ago and may have shared the earth with dinosaurs, yet today they still can be seen in almost any town. Many are colorful and cute. Others are incredibly weird. Some are tiny, and a few are giants. But wherever they live, bats play essential roles in the balance of nature. No other group of mammals is more diverse or better suited for captivating young minds to learn about the world around us.**

Discover Bats! **combines my personal experiences from a lifetime of research with the creative suggestions of experienced educators from many backgrounds. It is based on broad collaboration and is designed to stimulate students in grades 4-8 to have fun learning valuable concepts in the academic disciplines of science, language arts, social studies, mathematics, and much more. Some lessons are more advanced than others, but all are flexible and can be adapted for varied grade levels and uses.**

This is a dynamic resource, not limited to formal educational institutions or traditions. It is designed to encourage creativity among students and instructors alike. As you will also see, lessons from the world of bats provide compelling models for ensuring that education is fun. We encourage your comments and suggestions.



Merlin D. Tuttle
Founder and Executive Director
Bat Conservation International

As bats take what they need from their habitats, they also play a major role in keeping ecosystems healthy and in balance.

READ ABOUT BATS

Did you ever wonder what would happen if there were suddenly no more hawks, owls, or snakes to eat rats and mice, or if there were no more birds or bats to eat insects? The truth is, all animals and plants have important roles in the balance of nature.

Throughout the world, animals and plants live together in a variety of communities called **ecosystems**. The actual area within an ecosystem where an animal lives is called its **habitat**. Many plants and animals share unique habitats within each ecosystem, and they all must interact to take care of their basic needs—food, water, shelter, and space. No animals could survive without plants. Animals, from insects to deer, eat plants directly, and they in turn become food for other animals. In each ecosystem, plant-eaters keep the plants in balance, and **predators** keep the plant-eaters in balance.

How Do Scientists Study the Balance of Nature?

Scientists called **ecologists** have placed all living organisms into categories based on how they produce or consume energy. Plants are the **primary producers** of energy. Animals that eat plants directly, such as insects and rabbits, are called **primary consumers**. Bats and hawks that eat these primary consumers are **second-level consumers**. If a hawk catches an insect-eating bat instead of an insect or a rabbit, in that case, the hawk becomes a **third-level consumer**. Finally, if the hawk is then eaten by a bobcat, the bobcat becomes what ecologists call a **top-level carnivore**. For nature to stay in balance, there must always be fewer predators than **prey** at each level. A bat may require thousands of insects daily to stay alive, or a hawk may have to eat a dozen mice. Very few animals can find enough energy by feeding as top carnivores.

Finally, even carnivores die, and all organisms that die are recycled into new energy for the plants. The almost countless numbers of organisms that recycle energy are called **decomposers** or **detritivores** (dee-TRIT-ih-vores). Bacteria, **fungi**, fly maggots, and other decomposers break down organic matter, dead plants, and animals into new energy that can be used again by primary producers. Scientists who study animal relationships in ecosystems sometimes show the flow of energy from producers to **consumers** and carnivores by drawing **food chains**. To illustrate the role of all of these animals in the flow of energy from plants through consumers to top carnivores, they place the different categories of animals in a **food pyramid**. You can produce your own food chains and pyramids for plants and animals in a Costa Rican **rain forest** or even for those in your own backyard.

How Do Bats Share Similar Habitats in a Rain Forest

Ecosystem?

In a Costa Rican rain forest, dozens of species of bats can live in the same small area, because they have at least slightly different requirements. Some are **carnivores** that eat fish, while others eat lizards or frogs. *Carollia* (kah-ROLL-ee-ah) bats eat mostly **piper** fruits near the forest floor, while Jamaican Fruit-eating Bats eat mostly figs in the forest **canopy**. Nectar bats with different shaped noses visit different kinds of flowers. Broad-winged *Tonatia* (toe-NAH-tee-ah) bats pluck katydids from foliage, while narrow-winged free-tailed bats hunt only flying insects above the forest.

In addition to targeting different foods, bats also avoid competition by selecting slightly different kinds of roosts in the habitats where they live. For example, in the Costa Rican rain forest several species of bats live in tents they make from leaves, but each prefers to cut a different kind of leaf. *Tonatia* bats live in hollow termite nests. Sac-winged bats live beneath strangler fig vines, and many others live in hollow trees or caves. Those that live in hollow trees have many different requirements. Free-tailed bats like small holes and crevices in the tops of dead trees that rise above the canopy, while *Carollia* bats live in larger hollows near the ground. The more animals specialize in unique lifestyles, the more species can live together in a single area. Bats have **adapted** to live in a wider variety of places and eat a wider variety of foods than any other group of **mammals**. Do you suppose that might help explain why there are so many types of bats?

What Rain Forest Animals Eat Bats?

Bats aren't the only animals hunting in the rain forest. Many other predators exist. Hawks can catch bats as they emerge from their roosts at dusk. Later in the evening, owls, snakes, and other nocturnal predators hunt bats. Some predators sneak up on roosting bats during the day. A **coati** (coh-AH-tee) is an **omnivorous** raccoon-like mammal that eats a wide variety of food, including plants, fruits, snakes, and even bats. Like all animals, bats face the problem of finding enough to eat while avoiding predators that are trying to eat them.

Does the Variety of Bats Make a Difference for Other Animals?

As bats take what they need from their habitats, they also play a major role in keeping ecosystems healthy and in balance. Lesser Long-nosed Bats are important **pollinators** and **seed dispersers** for night-blooming cactus plants in the Sonoran Desert. Epauletted bats pollinate **baobab** (BAY-oh-bab) trees and are important carriers of seeds for many other trees in African **savannahs**. As pollinators, bats help plants to produce fruits and seeds. And as fruit-eaters they help carry seeds to places where they can grow. Plants, such as the baobab, rely on bats and are essential to the survival of countless other animals. Bats are also important to many of the world's most economically valuable plants. Their products include timber, balsa wood, and medicines, as well as many fruits in our local grocery stores.

In climates with cold winters, only insect-eating bats can survive, but even here they are very important. Without bats by night and birds by day, we could be overwhelmed by insects that eat our crops and destroy our forests. What do you think would happen to us, and to other animals, if insects ate all the plants?

Read More About Bats in the Balance of Nature!

Sunquist, Fiona. 1992. "Blessed are the Fruit Eaters." *International Wildlife*. 22(3): 4-10.

Tuttle, Merlin D. 1982. "The Amazing Frog-Eating Bat." *National Geographic*. 161(1): 78-91.

Tuttle, Merlin D. 1986. "Gentle Flyers of the African Night." *National Geographic*. 169(4): 540- 558.

Tuttle, Merlin D. 1991. "Bats: The Cactus Connection." *National Geographic*. 179(6): 131-140.

Discover Bats in the Balance of Nature on the World Wide Web at Bat Conservation International Website

Visit BCI's website and search through the 15 years of *BATS* magazines, or jump right now to these related topics!

Fleming, Theodore H., 1991. "Following the Nectar Trail." *BATS*. Vol 9(4):4-7.

Thomas, Donald w., 1991. "On Fruits, Seeds, and Bats." *BATS*. Vol 9(4):8-13

Glossary of words in this lesson

adapt (uh-DAPT) — to change to meet new or special needs; a species alters or adjusts itself to better survive in its environment

baobab (BAY-oh-bab) — a tree with a stout trunk up to 30 feet in diameter, with large, hanging flowers that are white and a hard-shelled fleshy fruit; found in tropical African savannas and provides food or shelter for many kinds of animals

canopy (CAN-oh-pee) — high, interlocking branches of large trees, as in a rain forest

carnivore (CAR-nih-VORE) — an animal which eats meat

coati (coh-AH-tee) — an omnivorous, racoon-like mammal that lives in tropical and sub-tropical habitats of the New World

consumer (con-SOO-mer) — an organism that feeds on other organisms or organic matter

decomposers(DEE-com-PO-zer) – an organism, especially bacteria or fungi, which breaks down non-living organic matter such as corpses, plant material, and the wastes of living organisms

detritivore (dee-TRIT-ih-vore) — a special class of consumers, such as bacteria and fungi, that derives energy from organic wastes and dead organisms

ecologist (ee-CALL-oh-jist) — a person who studies the relationships between animals and plants and their environments

ecosystem (EE-coh-SIS-tem) — all the interacting organisms of a community and their non-living surroundings regarded as a unit

food chain — a series of organisms, each eating or decomposing the preceding one, as when an insect eats a plant and then is eaten by a bat

food pyramid — a network of many interconnected food chains and feeding relationships, starting with a broad base of plant producers and animal consumers and peaking with only a few top level carnivores

fungus (FUN-gus); plural: fungi (FUN-guy) — a plant-like organism, lacking chlorophyll, which obtains nutrients and energy by secreting enzymes that break down organic matter in living or dead organisms (see also "detritivore")

habitat (HAB-ah-tat) — the environment in which an organism or population of plants or animals lives; the normal kind of location inhabited by a plant or animal

mammal (MAM-al) — a class of vertebrate animals that includes more than 4,000 species, distinguished by self-regulating body temperature, hair, and in the females, mammary glands (breasts) to nurse their young

omnivorous (OM-nih-ver-ess) – to be like an organism that eats both plants and meat, such as a bear or coati

piper (PIE-per) — a plant of the pepper family that produces fruit on upright or hanging stalks

pollinator (PAUL-en-ate-or) — an animal that pollinates plants

predator (PRED-ah-tore) — an animal that lives by catching and eating other animals

prey — a creature hunted or caught for food

primary consumer (PR'EYE-mare-ee con-soo-mer) — organisms that eat plants or algae, such as herbivores

primary producer (PR'EYE-mare-ee pro-DOO-sir) — any organism that is capable of manufacturing its own food from inorganic materials, usually accomplished by plants that create new energy from a combination of inorganic materials and sunlight in a process known as photosynthesis

rain forest — a dense, usually tropical, evergreen forest which receives heavy rainfall, more than 255 cm (100 inches) per year; generally found near the equator range map — a geographic illustration of where a species lives or can be found

savannah(suh-VAN-uh) – a grassland or prairie habitat with few trees, usually found in tropical or sub-tropical areas of Africa or South America

second-level consumer — in a food chain, the organism, a carnivore, which eats herbivores

seed dispersal (SEED dis-PER-sal) — the process of scattering seeds away from the parent plant, usually by an animal that eats the fruit and thus increases the probability that the seed will grow into a new plant

third-level consumer — in a food chain, a carnivore that eats another carnivore that ate a primary consumer

top-level carnivore — in a food chain, a meat-eating organism that eats other meat- eaters that have eaten primary or second level or third level consumers