



WHITE-LIPPED TREE VIPER: Southeast Asia

Venomous animals produce some of the deadliest poisons on the planet. They're also saving people's lives.

BITING BACK

Most people in their right minds avoid handling dangerous snakes. But not Mark Hockmuller, who picks up dozens of them every day. Hockmuller runs the Serpentarium, a research facility at Texas A&M University-Kingsville that's home to about 450 snakes. It's Hockmuller's job to care for the reptiles and collect the extremely poisonous *venom* they produce.

Today, Hockmuller and an assistant pull a Mojave rattlesnake out of its cage. This desert snake doesn't particularly like being handled—and its bite can kill a person.

Hockmuller grips the snake's head between his bare fingers and carefully guides it toward a cup covered with plastic film. The snake strikes at the cup, piercing the film with its fangs and spraying its venom into the container below.

Later, Hockmuller will ship the venom to researchers at universities,

drug companies, and other institutions around the U.S. that are studying these snakes and other venomous creatures. They're learning what makes venom so harmful, how to counteract its sometimes-deadly effects on human victims, and how it can even help us treat disease.

CHEMICAL WEAPONS

When you think of venomous creatures, snakes may be the first animals that come to mind, but they're far from the only ones. There are spiders, scorpions, lizards, insects, fish, and even mammals that make venom (see *Venom Diversity*, p. 17).

"Just about every order of animal has venomous members," says Bryan Grieg

Fry, a venom researcher at the University of Queensland in Australia. "There are hundreds of thousands of [venomous] species out there."

Many of these animals use their venom the way snakes do, to kill or immobilize prey. Others, such as stingrays, use it to defend against attackers. When male platypuses fight over territory, they stab at each other with venom-shooting spurs on their hind legs.

What makes venom such an effective weapon is its chemical composition. Venoms contain a mixture of poisonous molecules called *toxins*. When one animal injects another with venom, the toxins circulate throughout the victim's body and prevent it from operating normally.

An eastern coral snake's venom, for instance, contains *neurotoxins* that block

Continued on the next page



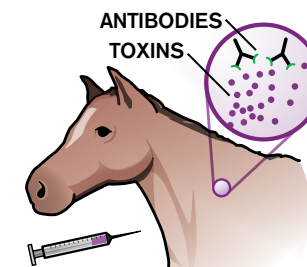
TEXAS CORAL SNAKE: Texas, Louisiana, Arkansas, and northeastern Mexico

HOW ANTIVENOM IS MADE

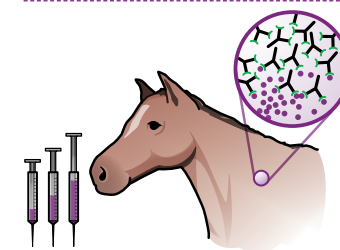
To make life-saving antivenoms, scientists enlist the help of horses that live on specialized ranches. The scientists inject the animals with a tiny, harmless dose of venom, which causes their immune systems to produce *antibodies*—proteins that attack and disable the venom toxins. Then the scientists can collect the antibodies and use them to treat people who have been bitten or stung.



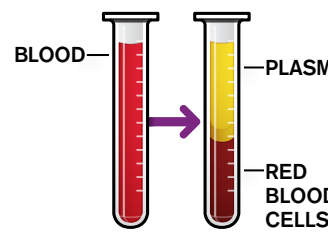
1 A technician extracts and later purifies venom from the species for which scientists want to make an antivenom.



2 A ranch hand injects a small, harmless dose of venom into a horse. The toxins in the venom trigger the horse's immune system to produce antibodies that neutralize those particular toxins.



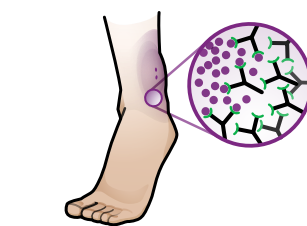
3 Over the next year, the horse receives several booster shots with increasing amounts of venom. Eventually, the horse produces so many antibodies that it's immune to the venom.



4 A ranch hand draws blood from the horse. A machine extracts the *plasma*, the part of the blood that contains the antibodies. The rest of the blood is returned to the horse.



5 The plasma is sent to a lab, where chemists purify it and package it as a liquid or freeze-dried powder. It is then shipped to hospital pharmacies.



6 When a patient comes in with a bite or sting, doctors use an IV line to inject the antivenom into the patient's veins. The antibodies circulate through the body and neutralize the toxin molecules.



WESTERN DIAMONDBACK RATTLESNAKE: Southwestern U.S. and northern Mexico



BEAUTIFUL PIT VIPER: Thailand

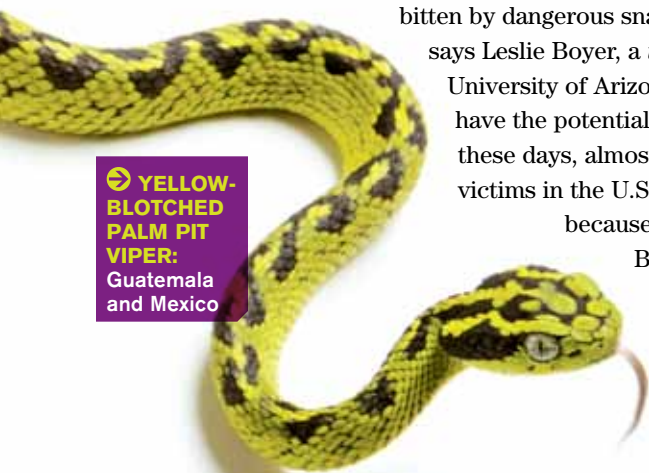
WATCH A VIDEO
www.scholastic.com/scienceworld

4 BONUS SKILLS SHEETS
www.scholastic.com/scienceworld



ANTIVENOM

🔍 SNAKE MILKING: Researchers extract venom from snakes like the Gaboon viper (above) to make antivenom and other drugs.



🔍 YELLOW-BLOTCHED PALM PIT VIPER: Guatemala and Mexico

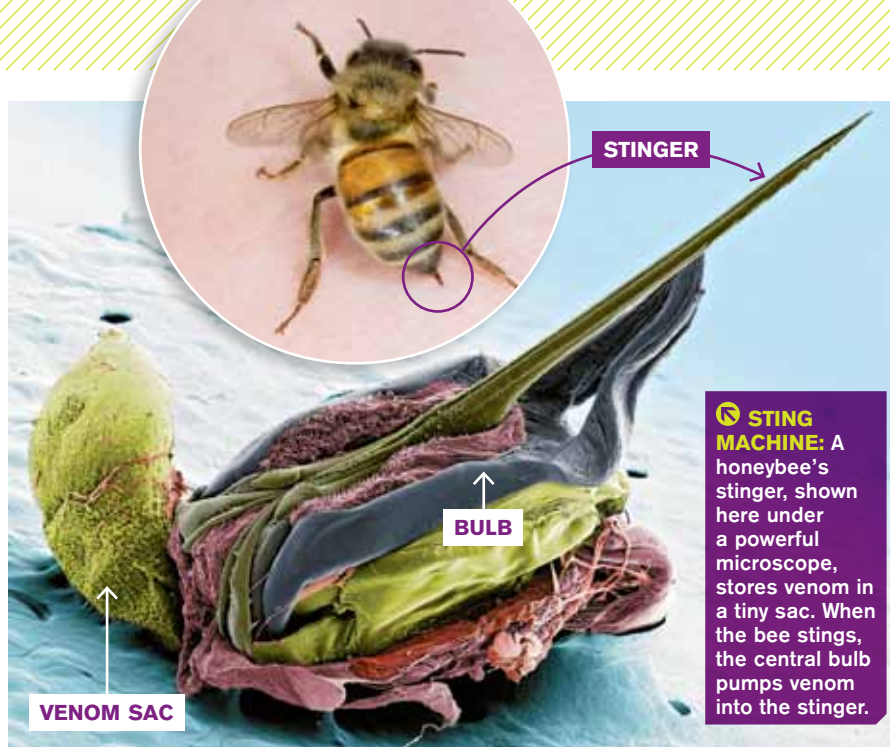
signals between the brain and muscles of its prey. This paralyzes the prey so that the snake can more easily eat it. Other venoms, like that of the diamondback rattlesnake, include toxins that prevent blood from clotting and cause their victims to bleed to death.

Every venomous species uses a slightly different mix of toxins that are specially adapted to disable its targets. For snakes, those targets are usually rodents and other prey. But snakes may also strike people who make them feel threatened—and their toxins can have similar lethal effects on us.

TREATING TOXINS

In the U.S., 8,000 to 10,000 people are bitten by dangerous snakes every year, says Leslie Boyer, a *toxinologist* at the University of Arizona. These bites have the potential to be deadly, but these days, almost all snakebite victims in the U.S. survive. That's because scientists like

Boyer have learned how to make *antivenoms*—medications that block the effects of venomous bites



STINGER

BULB

VENOM SAC

🔍 STING MACHINE: A honeybee's stinger, shown here under a powerful microscope, stores venom in a tiny sac. When the bee stings, the central bulb pumps venom into the stinger.

or stings. These lifesaving drugs are prepared in advance and kept in hospital pharmacies for when they're needed.

To make antivenom, scientists collect a sample of venom and inject it into an animal (see *How Antivenom Is Made*, p. 15). The dose is too low to hurt the injected animal. But the toxins trigger its disease-fighting immune system to produce *antibodies*—specialized proteins that attack and disable those particular toxins. Scientists then collect the antibodies and turn them into antivenom.

When a person comes into the hospital with a snakebite, doctors first question the patient to try to find out what type of snake bit him or her. Antivenom works only on the type of venom from which it was made, so doctors have to choose the right one. If they can't identify the snake, the doctors use an antivenom made from a blend of venoms from snakes common to the area. Then they inject it into the victim's veins.

"The antibodies go into the person's bloodstream," says Boyer. "They go throughout the body, and wherever they encounter the molecules of toxin, they neutralize it."

Antivenom saves people's lives. But it can't reverse any damage the venom has already done, says Boyer, so it's important for people who have been bitten or stung by venomous animals to seek medical attention quickly.

VENOM BENEFITS

Treating bites isn't the only reason to collect venom from animals like snakes. Scientists are studying the effects of the toxins in venom so that they can use those effects to our advantage—to treat disease.

Take the toxins that prevent blood clots from forming, says Elda E. Sanchez, co-director of the National Natural Toxins Research Center at Texas A&M. The large dose in a snakebite is dangerous. "But when you isolate those molecules," says Sanchez, "they can be used to [prevent] strokes and heart attacks, which are caused by blood clots."

Scientists are discovering lots of new medical uses for venom ingredients. The venom of the black mamba, an African snake with one of the deadliest bites on Earth, contains toxins that numb its victims. Last year, scientists figured out how to separate those compounds and turn them into a painkilling drug.

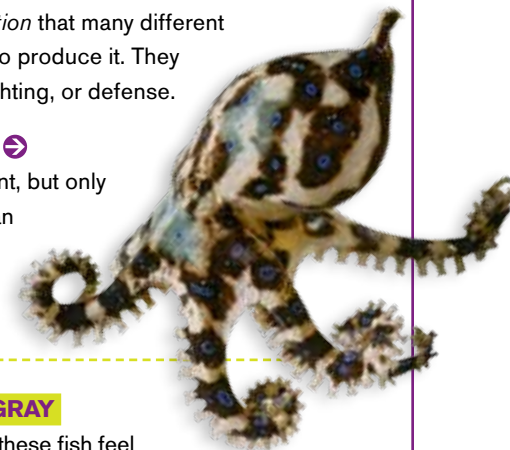
Others are studying *melittin*, the main component of honeybee venom. Bees inject melittin through their stingers. The chemical compound irritates the skin of their victims and triggers a severe allergic reaction in some people. But this past March, scientists

VENOM DIVERSITY

Venom is such a useful *adaptation* that many different types of animals have evolved to produce it. They use their venom for hunting, fighting, or defense.

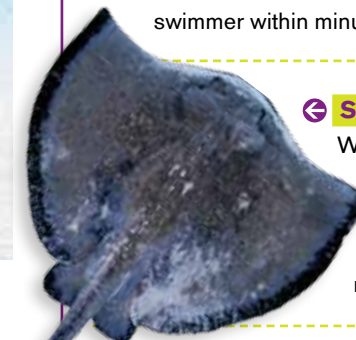
🔍 BLUE-RINGED OCTOPUS

All octopuses use venom to hunt, but only this 15 cm (6 in.)-long Australian species is dangerous to humans. Its bite can kill a swimmer within minutes.



🔍 STINGRAY

When these fish feel threatened, they use barbs on their whip-like tails to inject their attackers with venom. It contains toxins that damage muscle tissue and cause extreme pain.



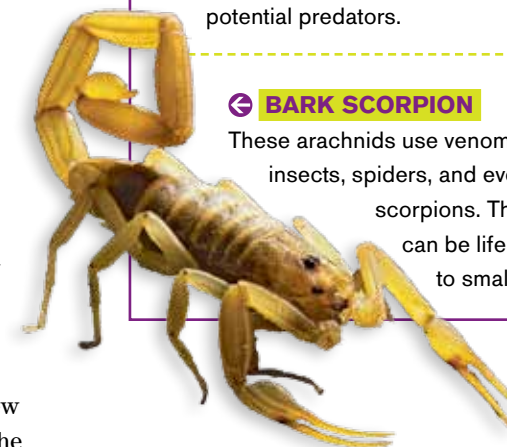
🔍 SLOW LORIS

The world's only venomous primates, slow lorises lick or rub toxin-producing glands on their arms to fill their mouths with toxins. Then they bite potential predators.



🔍 BARK SCORPION

These arachnids use venom to prey on insects, spiders, and even other scorpions. Their sting can be life-threatening to small children.



discovered that melittin can also kill the dangerous HIV virus in a laboratory dish.

Because venom is so useful in medicine, it may ultimately save the lives of many more people than it kills, says Fry. Unfortunately, many venomous creatures are now critically endangered. If they become extinct, we may never discover what their venom could do.

"Venomous species have already done all this work for us," says Fry. "We just have to be smart enough to keep them around." ❄️

—Mara Grunbaum

🔍 CORE QUESTION

Why do scientists collect venom from snakes and other venomous creatures?

DANIEL HEUCLIN/NATUREPL.COM (HARVESTING VENOM); © RIA NOVOSTI/SCIENCE SOURCE (ANTIVENOM); JOEL SARTORE/NATIONAL GEOGRAPHIC/GETTY IMAGES (PIT VIPER); © TED KINSMAN/SCIENCE SOURCE (STINGER); © SCOTT CAMAZINE/SCIENCE SOURCE (BEE)

VENOM DIVERSITY FROM TOP TO BOTTOM: DAVID DOUBILET/NATIONAL GEOGRAPHIC/GETTY IMAGES/PREDRAG VUCKOVIC/ISTOCKPHOTO.COM; © FRANS LANTING/MEDIA BAKERY; © CRAIG K. LORENZ/SCIENCE SOURCE