

LEARNING FROM

Can slumbering bears cure human ills?

Dave Garshelis peeks into a narrow opening under a log and comes face-to-face with a black bear snug in its winter den. Disturbing an animal weighing as much as 227 kilograms (500 pounds) may not seem like the safest thing to do. But it's all part of a day's work for Garshelis, a research biologist with the Minnesota Department of Natural Resources.

When the weather turns cold, Garshelis sets out to find where the bears are snoozing away the winter. "The variety of dens is pretty incredible," he says. Bears may dig a burrow underground, scrape together a nest of branches out in the open, or hole up in a pile of brush. Once Garshelis locates the bears, he sedates them to collect data on their health, and then tucks them back into bed.

Checking in on the bears allows Garshelis to keep tabs on Minnesota's bear population. It also offers scientists working with him the perfect opportunity to learn more about how these creatures hibernate. During the winter, a bear's *physiology*, or way its body functions, drastically changes

(see *Nuts & Bolts*, p. 11). For up to seven months, bears don't eat, drink, or take a bathroom break. Yet in the spring, most emerge from their dens as healthy as ever. How they manage this feat could hold the key to treating a host of human diseases.

NAP TIME

Faced with a shortage of food in the winter, bears hibernate as a way to conserve energy. During hibernation, bears' hearts beat at one fourth their normal rate, and their core body temperature drops by about 10 degrees Fahrenheit. Their *metabolism* (chemical reactions that maintain life) slows by as much as half, and they survive by burning fat they put on during the fall.

Massive bears hibernate much differently than smaller animals, like woodchucks and squirrels. For one, bears are light sleepers and will react if disturbed, while tiny hibernators sleep so deeply it's hard to rouse them at all. These small animals' heart rates come to almost a standstill, and their temperatures drop close to the freezing point. They also must periodically wake up to eat from their stockpile of food and eliminate bodily wastes before heading back to sleep.

DAMAGE CONTROL

One reason scientists want to study bears is that their heart function during hibernation can mimic some forms of human heart disease. When a person's heart doesn't pump blood properly, other organs are at risk of receiving too little oxygen. Bears, however, don't seem to suffer any ill effects from a lower heart rate.

Paul Iaizzo, a physiologist at the University of Minnesota, teamed up



WINTER HOME: Female bears wake up briefly during hibernation to give birth.

BEARS

CUDDLY CUBS: Garshelis holds a trio of cubs found while he was visiting a den.

HEAD FIRST: Garshelis shimmies into a den to pull out a sedated bear.



THE BEAR
FACTS

Hibernating bears have become popular medical subjects. How do you think studying their *physiology* (bodily functions) could help in the treatment of human diseases?



STRENGTH TEST: Under pressure, leg bones from hibernating and non-hibernating bears prove to be equally strong.

with Garshelis to implant heart monitors into sleeping bears. The data revealed that each time a hibernating bear takes a breath, its heart rate dramatically speeds up. "Bears' heart rate goes from 5 or 10 beats per minute to 60 or 70 beats per minute then back down again," says Iaizzo. He believes that the unusual rhythm allows a bear's heart to move the most blood when it has the highest oxygen content.

Bears' blood also contains a *hormone* (chemical messenger) called *hibernation induction trigger* (HIT), which appears to protect tissues receiving a reduced blood supply. Researchers like Iaizzo are studying HIT to determine if it could extend the life of donated human organs that are waiting to be transplanted. HIT also has potential as a treatment for people who are undergoing surgery or suffering from a heart attack or a stroke.

STAYING IN SHAPE

People who are bedridden become weak from not using their muscles and bones for long periods of time. This also happens to astronauts, who don't have to exert much effort to move in the weightlessness of space. "A bear scarcely moves for months, yet comes out of its den, gives a

yawn, and is on its way," says Garshelis.

Bears maintain their muscle strength and mass during hibernation with the help of specialized microbes in their gut. The bacteria turn *urea* (a by-product of muscles breaking down) back into a molecule that can then be turned into *protein*—

the building blocks of new muscle. This process also prevents toxic urea from building up in bears' bodies as it does in people with kidney disease. The kidneys usually filter urea out of



HEART MONITOR: Paul Iaizzo (wearing blue scarf) examines an ultrasound image of a bear's heart.

webextra

To learn more about the yearly life cycle of bears, visit:
www.scholastic.com/scienceworld

the blood and excrete it as urine. But bears' recycling system allows them to shut down their kidneys during the winter with no problem.

Seth Donahue, a biomedical engineer at Michigan Technological University, discovered that bears

also secrete a bone-building hormone that keeps their bones strong during hibernation. Humans produce a less-potent version of the same hormone, which is the model for a medication currently used to reverse *osteoporosis*, or bone loss in people. Donahue hopes to develop a new osteoporosis medication based on the bears' hormone. "We think the bear version will make an even better drug," he says.

MUSCLES Despite not moving for months, bears don't lose muscle. Figuring out how bears stay strong could help people who are bedridden or who have muscle disorders.

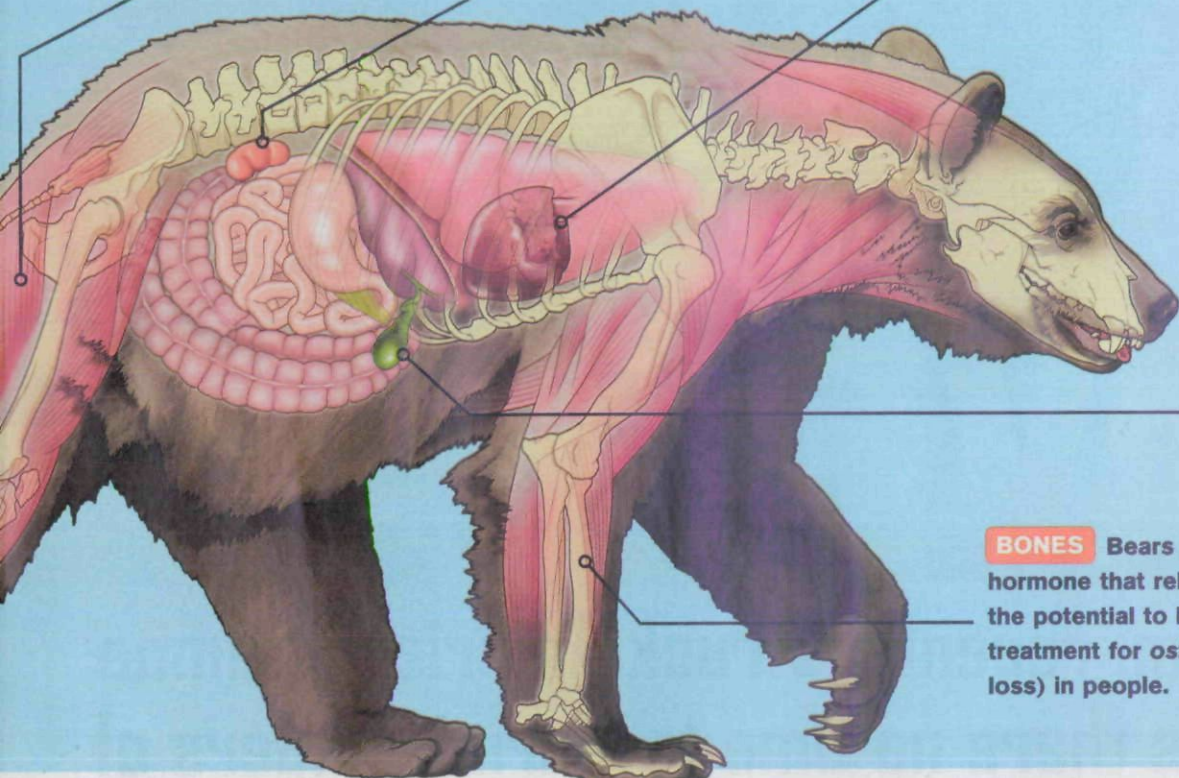
KIDNEYS Instead of relying on their kidneys to detoxify their bodies during hibernation, bears recycle their wastes instead. Understanding this ability could aid people with kidney disease.

HEART Bears' heart rates slow during hibernation then return to their normal pace in the spring. Studying bears' hearts could provide a way to treat human heart diseases.

GALLBLADDER

A chemical in bear bile, which is stored in a bear's gallbladder, dissolves *gallstones*. A synthetic version is currently used to break up these crystallized deposits in humans.

BONES Bears produce a powerful hormone that rebuilds bone. It has the potential to lead to an improved treatment for *osteoporosis* (bone loss) in people.



MODERN MEDICINE

Thanks to bears, doctors already have one treatment at their disposal. Bear *bile* (digestive juice that breaks down fat) contains a substance that dissolves some types of *gallstones*. Now doctors are using a lab-made form of the chemical to get rid of the painful deposits in patients.

Scientists believe bears still have much to teach us. "The more you study bears, the more unique things you find," says Iaizzo. Even NASA is interested in the sleepy science of hibernation. The space agency hopes studying bears can provide ways to keep astronauts healthy during lengthy missions.

—Cody Crane

it's your choice

1. Long periods of inactivity can weaken a human's _____ and _____.

- (A) liver, kidneys
- (B) lungs, heart
- (C) bones, muscles
- (D) heart, liver

2. A chemical found in bears is used to treat _____ in humans.

- (A) gallstones
- (B) diabetes
- (C) osteoporosis
- (D) cancer

3. Which of the following is NOT true about hibernating bears?

- (A) They must wake up periodically to eat.
- (B) They don't need to eliminate bodily wastes.
- (C) Their core body temperature drops by about 10 degrees Fahrenheit.
- (D) Their hearts beat at one fourth their normal rate.

DIAGRAM: BW INFOGRAPHICS; BONE: COURTESY PAUL IAIZZO; ENG: COURTESY DAVID GARSHLIS

Copyright of Science World is the property of Scholastic Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.