

**Questions 20-28 are based on the following passage and supplementary material.**

This passage is adapted from Tina Hesman Saey, "Lessons from the Torpid." ©2012 by Society for Science & the Public.

Understanding how hibernators, including ground squirrels, marmots and bears, survive their long winter's naps may one day offer solutions for problems such as heart disease, osteoporosis and muscular dystrophy.

Nearly everything about the way an animal's body works changes when it hibernates, and preparations start weeks or months in advance. The first order of business is to fatten up.

"Fat is where it's at for a hibernator," says Matthew Andrews, a molecular biologist at the University of Minnesota Duluth who studies 13-lined ground squirrels. "You bring your own lunch with you." Packing lunch is necessary because the animals go on the world's strictest diet during the winter, surviving entirely off their white fat. "They have their last supper in October; they don't eat again until March," Andrews says.

Bigger fat stores mean a greater chance of surviving until spring. "If they go in really chunky, nice and roly-poly, that's going to be a good hibernator," he says.

Bears also watch their waistlines expand in the months before settling in for the season. The brown bears cardiologist Ole Frøbert studies pack on the pounds by chowing down on up to 40 kilograms of blueberries a day. Such gluttony among humans could have severe consequences: Obesity is associated with a greater risk of heart attack and diabetes, among other ailments.

To see how fattening up affects Scandinavian brown bears, Frøbert and his colleagues ventured into the wilds of Sweden following signals given off by radio transmitters or GPS devices on tagged bears.

Bears can be dangerous close-up. Even hibernating bears can rouse to action quickly, so scientists tracking down bears in the winter use darts to tranquilize the animals from a distance. Scientists studying the bears in the summer tranquilize them from a helicopter.

Once a bear is under the tranquilizer's influence (which takes about five minutes), the scientists have 60 minutes max to get the animal from its den, weigh and measure it, draw blood samples and do minor surgeries to collect fat and other tissues. The bear is returned to its den by minute 61.

Precious materials collected during this high-pressure encounter need to be analyzed within 24 hours, so the researchers often test for levels of cholesterol or certain proteins in the blood while working in the snow or at a nearby research station. A pilot sometimes flies samples from field sites to a lab in Denmark in order to meet the deadline, Frøbert says. Samples such as bones and arteries that can't be collected from live bears come from bears killed by hunters during the legal hunting season.

Recent analyses revealed that Scandinavian brown bears spend the summer with plasma cholesterol levels considered high for humans; those values then increase substantially for hibernation, Frøbert and his colleagues reported. These "very, very fat" bears with high cholesterol also get zero exercise during hibernation. Lolling about in the den pinches off blood vessels, contributing to sluggish circulation. "That cocktail would not be advisable in humans," Frøbert says. It's a recipe for hardened arteries, putting people at risk for heart attacks and strokes.

Even healthy young adult humans can develop fatty streaks in their arteries that make the blood vessels less flexible, but the bears don't build up such artery-hardening streaks. "Our bears, they had nothing," Frøbert says. It's not yet clear how the bears keep their arteries flexible, but Frøbert hopes to find some protective molecule that could stave off hardened arteries in humans as well.

