HEALTH

You Could Probably Hibernate

The science of adapting to cold weather could change treatment of inflammatory diseases, insomnia, and trauma.

JAMES HAMBLIN JANUARY 16, 2020

Alien, Sigourney Weaver, 1986 (20TH CENTURY FOX / EVERETT)

Complaining about winter is one of the few remaining bastions of reliably safe small talk. Some people protest—*I absolutely love freezing*—but most will happily engage in winter bashing. In addition to widespread access to heated homes, offices, and vehicles, new industries continue to emerge on the promise of combatting winter. Moisturizing skin-care regimens are sold as the only way to keep our skin in one piece, and massive down coats are deemed necessary for spending even a few minutes outside. Sun-imitating lamps and vitamins promise to help us maintain a will to live.

Watching the struggle, as the cyclic abyss of winter sucks the vitality out of entire cities, I started to wonder about more comprehensive options. Maybe our minds and bodies are telling us we're not supposed to be fighting so hard. Maybe it would be easier and more efficient to just shut ourselves down—to stock up energy for the better months. As the days grew shorter and darker, the eyes on New York's subway emptier, I grew radicalized: It is absolutely ridiculous that we don't hibernate.

Aside from the social and financial impossibility of recreationally detaching for months at a time, hibernation turns out to be less physically impossible than I imagined. A small group of scientists is taking human hibernation extremely seriously. They are studying the basic mechanisms with an eye to all kinds of applications, such as preserving pulseless trauma victims while critical injuries are repaired, deep-space travel, and altering metabolic rates to help people lose weight.

"It's very possible that humans could hibernate," says Kelly Drew, a professor at the University of Alaska's Institute of Arctic Biology. Drew studies arctic ground squirrels, chunky little creatures that disappear into burrows for eight months of the year. When she and I spoke, it was 35 degrees Fahrenheit below zero (without wind chill) at her lab in Fairbanks, at 2:00 in the afternoon (just before sunset). Suddenly my case for hibernation felt trivial.

The essence of hibernation, Drew explains, is body-temperature regulation. Dropping the body's core temperature induces a low-metabolic state of "torpor," in which animals require almost no food. Most of the calories we "warm-blooded" animals burn go into maintaining our body temperatures—our basal metabolic rate. The squirrels Drew studies, for example, curl up into little balls and plummet from 99 degrees to 27. This drops their basal metabolic rate by about 99 percent.

Even dwarf lemurs, primates like us, can similarly reduce their caloric needs to 2 percent by dropping their temperatures. Humans unfortunately seem to have a stubbornly fixed set point: 98.6 degrees. Apart from minuscule daily fluctuations like a night-time drop that coincides with sleep, our temperatures only change as an indication of peril—fever or hypothermia. Just a few degrees can mean the difference between health and imminent death.

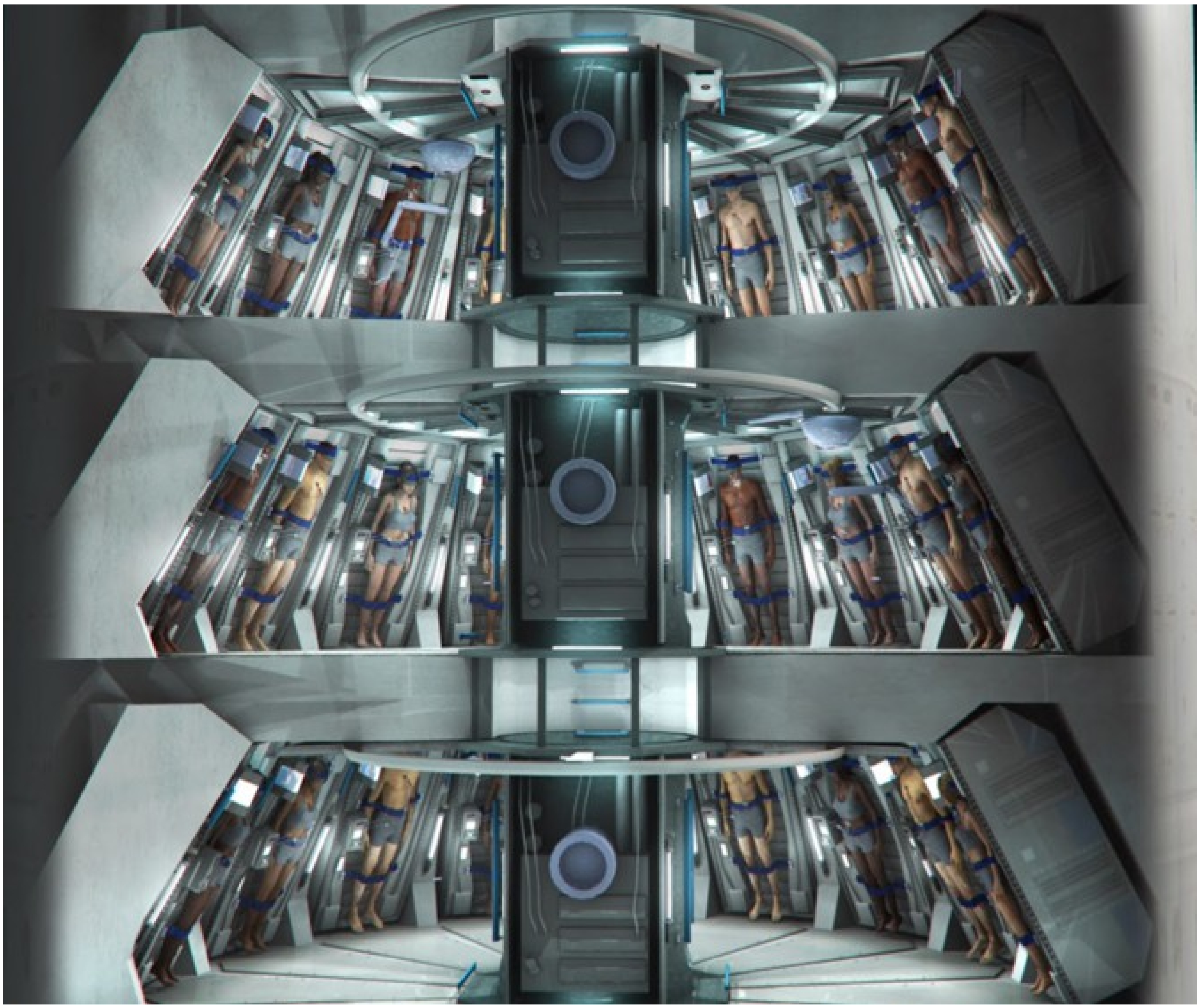
This set point was long thought to be immutable, but it may not be. Even though humans don't typically go into torpor of their own volition—and our bodies typically prevent it by shivering—Drew explains that there's no single "hibernation molecule" or organ that humans lack. In fact, torpor can be induced by doctors in extreme circumstances. Surgeons, for example, use hypothermia during procedures in which the heart must be stopped for a prolonged period—allowing the brain and other organs to survive longer while deprived of fuel. Cooling is also used in emergency cases after cardiac arrest. Covering sedated patients in blankets that circulate cool water is believed to have a similar effect to putting an ice pack on a sprained ankle, decreasing the inflammatory process to minimize lasting damage to the heart and central nervous system.

Cooling is now widely practiced in hospitals, and some doctors have come to believe the principle could be taken further—essentially keeping people alive after they die. At the University of Maryland, the surgeon Samuel Tisherman is studying what he calls "emergency preservation and resuscitation," or EPR, an experimental protocol in which doctors rapidly cool trauma victims whose heart stops beating. This could buy time for emergency surgery. Right now, in a severe trauma case, a patient may only have a matter of minutes to live—not enough to make it to the operating table. For example, Tisherman describes a person with a gunshot wound to the aorta who's bleeding internally, very quickly. If that person's heart stops, Tisherman's team will surgically open the chest and massage the heart to keep it pumping as they try to repair the aorta. This only takes a few minutes, but when the patient loses too much blood, it's over. Deprived of oxygen, the brain dies within minutes.

Cooling could extend that crucial window. Even with the heart stopped, the brain can survive for roughly two hours at a low enough temperature, Tisherman explains. Inducing torpor in such circumstances would mean cooling would have to happen very quickly—requiring a team of anesthesiologists, surgeons, and cardiologists all working in step with almost no advance notice. But the science is there. "These injuries are technically fixable," Tisherman says. "The limitations are more logistical than physiological."

This raises the question of other ways this physiology could be altered, therapeutically or otherwise. If a fatally wounded person could be kept alive, could temperature be used to slow metabolic processes in less extreme scenarios? How long could a person stay "hibernating" in good health?

This question is being treated seriously by NASA. Beginning in 2014, the agency funded research on long-term hibernation as a way to facilitate long-term space travel. Going to Mars, for example, is limited by the stubborn needs of astronauts to do things like eat and move around. But if their metabolic processes could be slowed to almost zero, they could theoretically travel much farther. “The obvious benefit is needing less food,” says John Bradford, an aerospace engineer who worked with the agency to develop a human-hibernation protocol. One crew member would stay conscious while the others hibernated for two-week periods. They could be kept in small pods, minimizing the amount of space in the ship that needs to be encased in radiation-blocking shields, which are extremely heavy and fuel-inefficient.



A rendering of hibernation vaults for long-term space travel (SpaceWorks / NASA)

Though his protocol hasn’t actually been executed, Bradford is optimistic. “We couldn’t find any showstoppers, any reason it wouldn’t be possible,” he says. Still, the risk of medical complications is not zero. Because our bodies don’t store food reserves, the astronauts would have to be fed through a tube (surgically inserted by boring a hole through the front of the abdomen into the stomach). Bradford says the biggest challenge would be dropping people's temperatures without causing them to shiver and burn up energy. In hospitals, shivering is overcome with sedative medications, but Bradford's team is wary of having a team of astronauts take heavy sedatives for weeks or months.

What's really needed is a drug that could drop a person's core temperature safely, inducing torpor of the sort that so many other species enjoy. Bradford and Tisherman both point to this sort of drug as a potential breakthrough—a way to address the clearest limiting factors in their work. And, in fact, the arctic-squirrel biologist Drew has a drug that she believes could do exactly this. She describes its function as "turning down your thermostat." It works reliably in rats, a nonhibernating animal that has served as her experimental model, and Drew is in talks with the U.S. Food and Drug Administration about human testing. In 2019, the National Institutes of Health funded her work with an $11.8 million dollar grant, suggesting the appeal of such therapies for humans is not limited to those who are technically deceased or en route to Mars.

Cooling has the potential to play a part in treating many inflammatory diseases, says Drew. She is also interested in the role of thermoregulation in insomnia. In some cases, the disorder seems to be due to a flaw in the human body's standard cyclic dip in temperature each evening, so temperature-modulating drugs could help induce sleep. Other researchers, meanwhile, are studying how temperature-dependent metabolic pathways are affected in obesity and diabetes, and whether they could be reset. As Drew puts it, "Thinking about body temperature as something we can control is the beginning of a major change in medicine."

As for using such a drug to electively hibernate from January to March, I'm now certain that would kill me. Beyond the issue of the brain's thermal set point, there are anatomical barriers for humans. For example, Drew says that her rats can only be induced into hibernation for about two weeks before they develop sepsis, apparently because of a breakdown of the bowel wall. Many hibernating animals have guts that are anatomically adapted to the practice, unlike ours. Black bears do have guts more similar to humans', and they sustain hibernation by cycling through a range of body temperatures instead of plummeting for entire months. Human hibernation would likely require similar cycling, which would be more complicated than simply switching off the body's thermostat with a pill.

A final flaw in my (already apparently fatal) winter hibernation plan is that hibernation is different from sleep, and doesn't clearly have the same restorative benefits. Even if I managed to stay unconscious without having my bowels rupture, Bradford explained, I wouldn't necessarily come out feeling rested. "I'm sure there are people who would love to kind of punch out for a weekend or a week," he said, "but we don't know if there's any therapeutic benefit to doing that."

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