

Braving the cold to understand what makes squirrels tick

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For most of us, our day begins with an alarm of some sort. We work, eat,

and play, all on some sort of a schedule. While our world is dictated by mechanical clocks, the schedule of the non-human animal kingdom is largely dictated by internal clocks. This raises the question, what really makes animals tick?

Many mammal species in colder climates spend the winter months in torpor, a state of decreased physiological activity commonly known as hibernation. During this period of torpor, many bodily functions are suppressed to conserve energy, including the daily clock known as the [circadian clock](#). Much is known about how circadian clocks operate during active periods; for instance, sunlight is the primary cue for [internal clocks](#) in many species, but the role of clocks in torpor is largely unknown. Do circadian clocks persist throughout torpor?

In blistery Anchorage, Alaska, Dr. Cory Williams of the University of Alaska, Anchorage, is braving the cold and snow to understand such clocks. His research animal is the arctic ground squirrel, chosen for its interesting winter hibernation conditions. Their hibernacula, the dens where they hibernate throughout the winter, can completely freeze in the cold winter. As a result, the [squirrels](#) go into a deep torpor, where their body temperatures can go as low as -3°C . So, do their clock-like rhythms persist at these extreme temperatures?

To answer this question, Dr. Williams used a combination of field and laboratory experiments. In the field, Dr. Williams and his team investigate the association between time of emergence from hibernation and the resumption of body temperature. In the lab, the team assesses the rhythmicity of squirrels by manipulating their light exposure and torpor conditions.

Their new results show that during winter hibernation, the squirrels' [body temperatures](#) are low and show no evidence of rhythmicity. In the lab, squirrels kept in constant darkness still develop body temperature

rhythms upon re-emerging from hibernation, even in the absence of light cues. These results are among the first to confirm that the squirrels' clocks are not active during a period of torpor.

While the results of the experiments focused on the emergence of squirrels post-hibernation, Williams also noticed that male squirrels would enter their hibernacula two weeks prior to entering hibernation. Unexpectedly, they would continue to be rhythmic right up to entering hibernation. Williams speculates that this two-week disparity between entering and hibernating may have something to do with food caches. Squirrels may store food in those two weeks in the fall, enter torpor, and then have food stores in the spring after emerging from torpor but prior to actually leaving their hibernacula. However, at this point this hypothesis has not yet been tested.

Why does this matter? From the squirrels' perspectives, research on these animals is among the first to show a complete absence of rhythms during a period of torpor, opening the door for future studies on other animals that also enter torpor, such as bears during winter hibernation. For humans, who do not enter torpor, studying squirrels can potentially help us understand our own rhythms. A slew of human health issues, such as certain cancers and cardiovascular diseases, can be traced back to dysfunctional internal clocks. Perhaps research into what makes animals tick can help us to tick better.

Williams presented this research at the 2015 annual meeting of the Society for Integrative and Comparative Biology in West Palm Beach, Florida.

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