

# Why Do Animals Enter Torpor at Specific Times of Day?

## Key Points

- Researchers identified a neural mechanism by which the brain's circadian clock controls the timing of torpor.
- GABAergic neurons projecting from the suprachiasmatic nucleus (SCN) to the preoptic area (POA) regulate when torpor occurs.
- Disrupting inhibitory signaling from AVP neurons in the SCN impairs normal torpor timing.
- The findings provide new insight into how circadian clocks coordinate survival strategies

## Summary

A research team led by Daisuke Ono, Shota Miyazaki, and Chang-Ting Tsai discovered a neural circuit that determines when animals enter torpor, a state of dramatically reduced body temperature and metabolism used to survive food shortages and cold environments. Using mice, the researchers found that GABAergic neurons projecting from the SCN to the POA are critical for regulating torpor timing. They further demonstrated that GABA released from AVP neurons within the SCN is required for normal torpor induction. The study reveals how the brain's master clock controls a fundamental survival strategy and may ultimately contribute to efforts to induce controlled low-metabolic states for medical applications and future space exploration. The findings were published in Nature Communications.

## Research Background

Torpor is an adaptive physiological state characterized by profound reductions in body temperature and metabolic rate. Previous studies suggested that torpor occurs at specific times of day and is regulated by the circadian clock, but the underlying neural mechanisms remain unknown.

## Research Results

Wild-type mice entered torpor primarily during the late night and early morning, whereas mice with disrupted circadian clock output exhibited torpor throughout the day. Optogenetic activation of SCN neurons suppressed torpor, indicating that SCN activity acts as an inhibitory signal. Brain-wide analyses identified the preoptic area as a key downstream target. Selective activation of SCN projections to the POA strongly suppressed torpor. Disrupting neural output from the SCN abolished normal torpor timing. The researchers further demonstrated that GABA released from AVP neurons in the SCN is essential for

normal torpor regulation.

### **Research Summary and Future Perspective**

This work identifies a neural circuit through which the circadian clock governs torpor timing. The findings advance our understanding of how the brain coordinates metabolism, thermoregulation, and survival behaviors. Understanding how animals naturally enter low-metabolic states could eventually contribute to medical technologies aimed at reducing metabolic demand during critical illness and may provide insights relevant to long-duration space missions.

### **Publication**

Sheikh Mizanur Rahaman, Shota Miyazaki, Chang-Ting Tsai, Akihiro Yamanaka, Chi Jung Hung, Michihiro Mieda, Takahiro J. Nakamura, Hiroshi Yamaguchi, and Daisuke Ono. 2026. GABAergic projections from the suprachiasmatic nucleus to the preoptic area regulate the timing of torpor in mice, Nature Communications.

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