

Circadian cycle even more important to life than previously suspected: study

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Researchers at USC were surprised recently to discover just how much the rising and setting of the sun drives life on Earth – even in unexpected places.

Their findings, which appear this month in the *Proceedings of the National Academy of Sciences*, "speak volumes to the evolution of [life on Earth](#)," according to USC scientist Andrew Y. Gracey.

"Everything is tied to the rotation of the planet," he said.

In all organisms, a certain amount of gene expression (the process by which products are created from the blueprint contained in genes) is rhythmic. In creatures that live on land, that rhythm is unsurprisingly tied to the 24-hour day, known as the [circadian cycle](#).

Mussels – which Gracey chose to study – instead spend their entire lives in dark shells in an area between the land and the sea, submerged or exposed depending on the tide.

Most of their physical activity is based on the tidal cycle; when mussels are exposed to the air, they close their shells and switch to an anaerobic metabolism, starving for oxygen, and when submerged they breathe and feed.

"It's a really profound change in their biology as they go from sea to land," said Gracey, assistant professor of biological sciences at the USC

Dornsife College of Letters, Arts and Sciences.

One would expect, then, that the tidal cycle would be the clock that drives their gene expression. But in fact, as Gracey's tests discovered, while a "tidal clock" probably does exist for mussels, the lion's share of their [gene expression](#) is instead driven by the circadian cycle.

"The circadian cycle is trumping the tidal cycle," Gracey said.

Gracey and USC graduate student Kwasi Connor constructed an aquarium with an artificial tide by pumping water in and out every six hours. For four days straight, Connor collected samples every two hours – getting excellent data, but not much sleep.

"That's why this paper is so good; we have such a high resolution," Gracey said.

Connor shrugged off the sacrifice in the name of science: "It's critical that you get up and do measurements in a precise manner, otherwise you lose the value of the data," he said.

Later, Gracey and Connor ran a similar simulation in a more natural environment by suspending cages of mussels off of a dock, this time for 50 hours.

The results were unexpected. Of the genes that showed rhythmic expression, between 80 and 90 percent were driven by the circadian cycle.

Provided by University of Southern California

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