The Significance of Biological Rhythms

Mice don't own alarm clocks – so how do they know when it's time to wake up? Mice are nocturnal which means they are most active at night. Something inside of them causes them to wake up in the evening and go about their business. This behavior is probably useful since the darkness hides them from predators.

Similarly, owls do not get up with the sunrise, but rather hunt at night when some unlucky mouse is likely to become their dinner. It's clear that the ability of these creatures to match up their behavior with nature's rhythms (like the day and night cycle) is critical for their survival.

The activity patterns of mice and owls are examples of biological rhythms that are synchronized to the day/night cycle. These patterns are called **circadian rhythms**. This phrase has Latin roots. *Circa* means "about" and *dian* means "a day." A circadian rhythm cycles over a one day period.

Other biological rhythms are tied to the tides or the season which are much longer (from hours to months). Circadian rhythms are important because they influence so many aspects of our daily lives. These rhythms influence everything from when we get tired, to when we feel at our best, to when we are hungry.

Scientists have discovered that our bodies have over 100 biological rhythms. For example, our blood pressure peaks at 7 a.m. and our different hormone levels rise and fall throughout the day. These discoveries can affect everything from when we should take certain medications to safety precautions for people working night shifts.

As scientists began studying circadian rhythms, they asked questions such as, "How are these rhythms maintained?" and "What keeps them so regular?" One idea was that something in the environment – outside of the organism –kept the rhythm going. For example, some scientists hypothesized that the rising or setting of the sun must control the wake/sleep cycle in animals. This would mean that the owl or mouse would have to somehow sense the setting of the sun in order to become active.

Other scientists argued that there had to be more to it than that. For example, it is often not enough for an animal to just react to some change in its environment (like the sun coming up). Sometimes they have to anticipate and be ready for such events in order to survive. These rival hypotheses demonstrate how scientists can have differing ideas to explain the same natural phenomenon.

Consider the example of the earthworm. Earthworms come out at night and retreat underground before the sun comes up. If the worm is going to avoid being seen by predators or harmed by the sun, it has to retreat underground *before* it starts getting light. In other words, if the worm wants to avoid the early bird, it has to anticipate the rising of the sun. This simple example suggests that something more than external cues are used by organisms to set their daily cycles. This argument says that circadian clocks offer organisms a survival benefit by allowing them to *anticipate* events such as sunrise and sunset.

In order to figure out whether or not external factors control circadian rhythms, scientists have performed what are called "free-running" experiments. In these experiments, the scientists create a controlled environment where there is constant darkness. If you were inside one of these environments, there would be no way to tell if it was day or night.

Scientists have used free-running experiments to study sleep cycles in many organisms, including humans. In these studies, people live in a controlled environment where there are no clocks and they can't see outside to know whether it is night or day. Remember, in order to test the truthfulness of a scientific explanation, it's not enough to **JUST** have an idea or hunch, but scientists must conduct carefully controlled experiments.

In one experiment, a person spent almost two months living in a deep cave where he was unable to tell if it was night or day outside. He carefully recorded his sleep/wake cycle the whole time he was in the cave. This record of his sleeping and waking was the scientific data (evidence) that have helped scientist discover some interesting things about human sleep cycles (explanations).

In a little while you will look at the actual data from the cave experiment, but first you need to understand a few things about how scientists measure circadian rhythms. To better understand how scientists measure and interpret sleep cycle data, you are going to examine data from a free-running experiment with a human being.