

Shedding Light On The

# CIRCADIAN

BY KIMBERLY SHAIN PARSLEY



**IF YOU HAVE EVER TAKEN A PLANE ACROSS SEVERAL TIME ZONES, THEN YOU PROBABLY KNOW ABOUT THE CIRCADIAN CLOCK, ALTHOUGH YOU LIKELY DIDN'T CALL IT THAT. WHAT YOU MIGHT NOT KNOW IS THAT THE CIRCADIAN CLOCK, WHICH IS RESPONSIBLE FOR THE FEELING KNOWN AS JET LAG, IS PRESENT IN ALMOST EVERY LIVING ORGANISM.**

Dr. Sigrid Jacobshagen, associate professor of biology at Western Kentucky University and current director of the Biotechnology Center, is interested in learning more about the circadian (or biological) clock. The word circadian comes from the Latin *circa* meaning "about," and *dian* meaning "day," she explained, adding "It means a rhythm that is about a day long."

Dr. Jacobshagen said that medical researchers are finding links between the circadian clock and some forms of depression, mental disorders, sleep disorders, and weight gain. "It even goes further," she said. "Scientists have discovered that in cancer research the circadian clock is important." She said studies have shown that an individual's ability to fight off cancer has a circadian component. Some drugs appear to be more effec-



*Dr. Sigrid Jacobshagen*

tive in combating certain cancers based on the time of day they are administered. She said that "cronotherapy," the study of how time affects medication, is becoming increasingly popular.

"There is currently a lot of interest in the biological clock," continued Jacobshagen. "This is basic research, but also applied, in terms of medicine and agriculture. The agricultural implications of circadian research could have positive benefits on livestock breeding seasons, growing seasons, and crop optimization."

Dr. Jacobshagen's research of the circadian clock deals with the

organism *Chlamydomonas reinhardtii*, a kind of green alga. "I'm working on a green alga that is also used to study other phenomena," she said. "The advantage is quite a lot of research groups work on this organism, so I can also rely on their results for certain methods and knowledge."

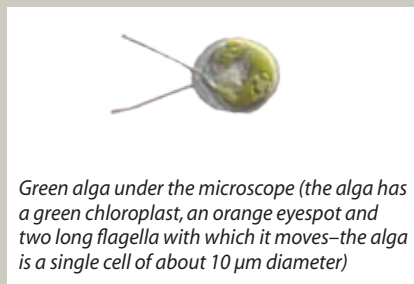
Algae too have a circadian clock. Dr. Jacobshagen said that a circadian clock has even been discovered in a certain group of bacteria. She will be able to compare her results to those from plants, which are evolutionarily closely related to *Chlamydomonas*.

"I'm interested in basically two aspects," she said. "One is how the

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biological clock regulates certain things, and specifically how it regulates the expression of genes. The second is how the biological clock is trained or adjusted to the outside cycle — for example, light or dark, and temperature — that you have over a day.”

Dr. Jacobshagen said the regulation of genes by the circadian clock in the green alga of her study is very common, even more common than she first suspected. She said that to make that determination, she and her students measure how much RNA [ribonucleic acid] is synthesized from these genes over the course of a day. To understand what is regulating the genes, they isolate mutant algae that are defective in circadian regulation. By doing this, they can conclude that the mutant gene was responsible for the regulation. “We also look at the



the light. “The biological clock is, in a way, different from some other phenomena. For example, how a cell divides is very much the same in all animals and plants. But with the biological clock, there are more differences, so it’s also a question of what is the protein that adjusts the clock in a particular organism.”

She finds this protein to be a very interesting subject of study. The protein that adjusts the circadian clock in insects, for example, is

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gene,” she said, “particularly, what part of the gene is the regulatory component.”

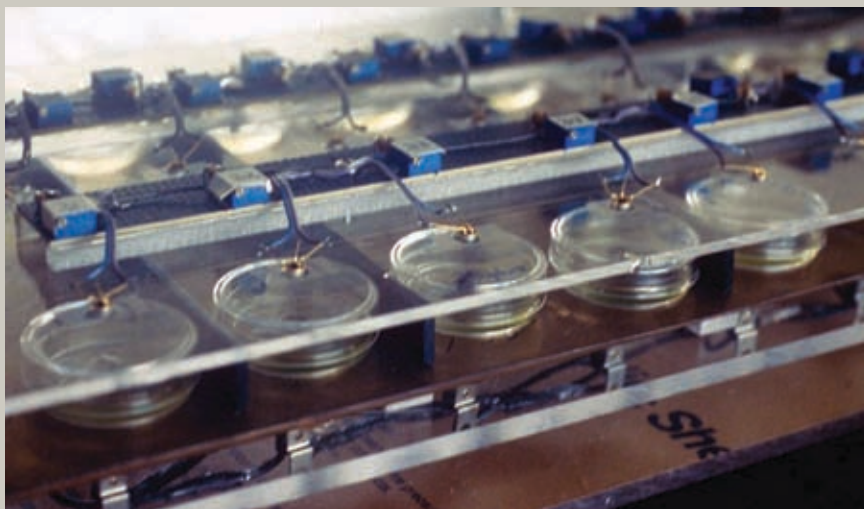
Phototaxis is one circadian rhythm expressed by the green algae. Phototaxis, Dr. Jacobshagen explained, is essentially an organism’s ability to “swim toward the light.” She has a phototaxis machine that measures this phenomenon. “When they think it’s day, even when you have them in constant conditions, they swim toward the light. When they think it is night, they don’t do it.”

She said her study focuses largely on the protein that allows the cell to see the light and then adjust to

present in humans, but it performs a different function. Rather than adjusting the circadian clock, it is part of the clock that creates the cycling. “It is still not really understood how it came about or what makes these variations in different organisms,” Dr. Jacobshagen said.

Students are very important to her research, and Jacobshagen believes the research experience is extremely valuable for the students as well. “Understanding the research part of the sciences is very important for students because that’s how knowledge is gained. It’s learning experimental thinking and progressing that gives students such an edge in addition to lecture and formal labs,” she said.

Dr. Jacobshagen, who has been at Western for more than ten years, said the combination of teaching and research is the aspect of Western that she most enjoys. Western’s emphasis on molecular biology was also a draw for her. “Western was very attractive for my kind of research because of its strength in molecular biology and its Biotechnology Center.” She added, “The Biotechnology Center makes Western special as a comprehensive university.”



*A phototaxis machine measures the circadian rhythm of phototaxis or swimming towards light.*