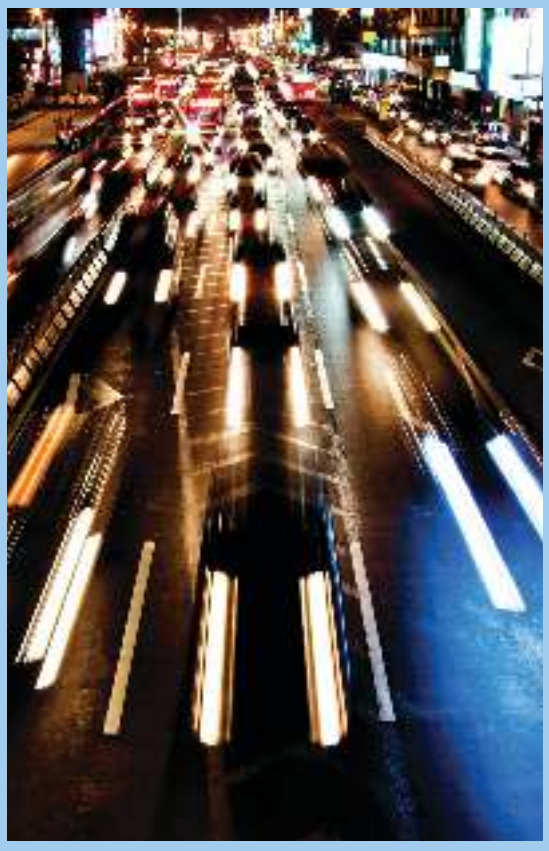
nucleus (SCN), the brain's master clock. They project to many other brain regions as well, influencing myriad aspects of human physiology. Moreover, research would show, they are uniquely sensitive to blue light.

The discovery of a new photoreceptor was largely unanticipated given that the eye's anatomy had been well described for more than a century. But Russell Foster, now head of the Nuffield Department of Ophthalmology at the University of Oxford, United Kingdom, wasn't all that surprised. In the early 1980s, Foster was researching avian circadian tracking. It had long been known that birds use neither eyes nor pineal gland for circadian entrainment, but had other, anomalous photoreceptors deep in their brains. By the early 1990s he had begun work on fish and mammalian circadian tracking.

In his early mammalian experiments, Foster tested the ability of light to disrupt circadian rhythms in blind mice with rods and cones that were badly damaged from a genetic disorder. The mice entrained normally, so he hypothesized that mammals, like birds, might also have nonvisual photoreceptors. To test that hypothesis, he engineered mice with rodless, coneless eyes. "To our intense pleasure, regulation of the body clock seemed perfectly preserved," he says. "We were definitely dealing with a new receptor."

As a graduate student in Foster's laboratory at the University of Virginia in the early 1990s, Ignacio Provencio, now an associate professor in the university's Department of Biology, had tried frequently, creatively, and ever vainly to identify the photoreceptors that reset the SCN. Later, as a postdoctoral researcher at the Uniformed Services University in Bethesda, Maryland, in what he viewed as a detour from these efforts, he studied dermal melanophores, photosensitive skin cells from the frog *Xenopus laevis*. The melanophores turn dark when illuminated and light in darkness; they probably function as camouflage, says Foster. The researchers suspected that opsin-triggered photopigments mediated the color change, and Provencio cloned a new photopigment dubbed "melanopsin" from the frog skin cells.

Provencio searched histologic sections of frog tissues for melanopsin, ultimately identifying the compound in eye and brain tissue in research he published in the 6 January 1998 issue of *Proceedings of the National Academy of Sciences*. He then identified homologs in the eyes of mice and



Blue light, subtle and dramatic, surrounds us, its special properties serving many purposes. When it comes to light perception, glare and brightness are both functions of wavelength; the short wavelength of blue light appears relatively bright to human eyes, making this among the most energy-efficient colors of light to produce. The bright bluish light emitted by high-intensity discharge headlamps thus increases visibility while using less energy than halogen headlamps, but that brightness also can heighten glare for oncoming drivers, particularly elderly drivers, who may already have trouble seeing at night. Now-ubiquitous compact fluorescent lamps (CFLs) similarly produce more light with less energy compared with incandescent lamps, and the bluer the CFL ("daylight" bulbs have the bluest color balance), the more energy efficient. More dramatic blue light is found in dental offices, where blue curing lights are used to harden amalgam material (orange goggles and filters provide eye protection against the intense light). The specific wavelength and intensity of the curing light stimulates a photoinitiator in the amalgam to decompose and initiate polymerization of the compound. But don't think blue light is all work and no play—some, like that cast by the sea of Christmas lights at Tokyo Midtown, serves little purpose other than sheer enjoyment.

Clockwise from left: punksid/Shutterstock; Feng Yu/Shutterstock; Lucian Coman/Shutterstock; © Yuriko Nakao/Reuters