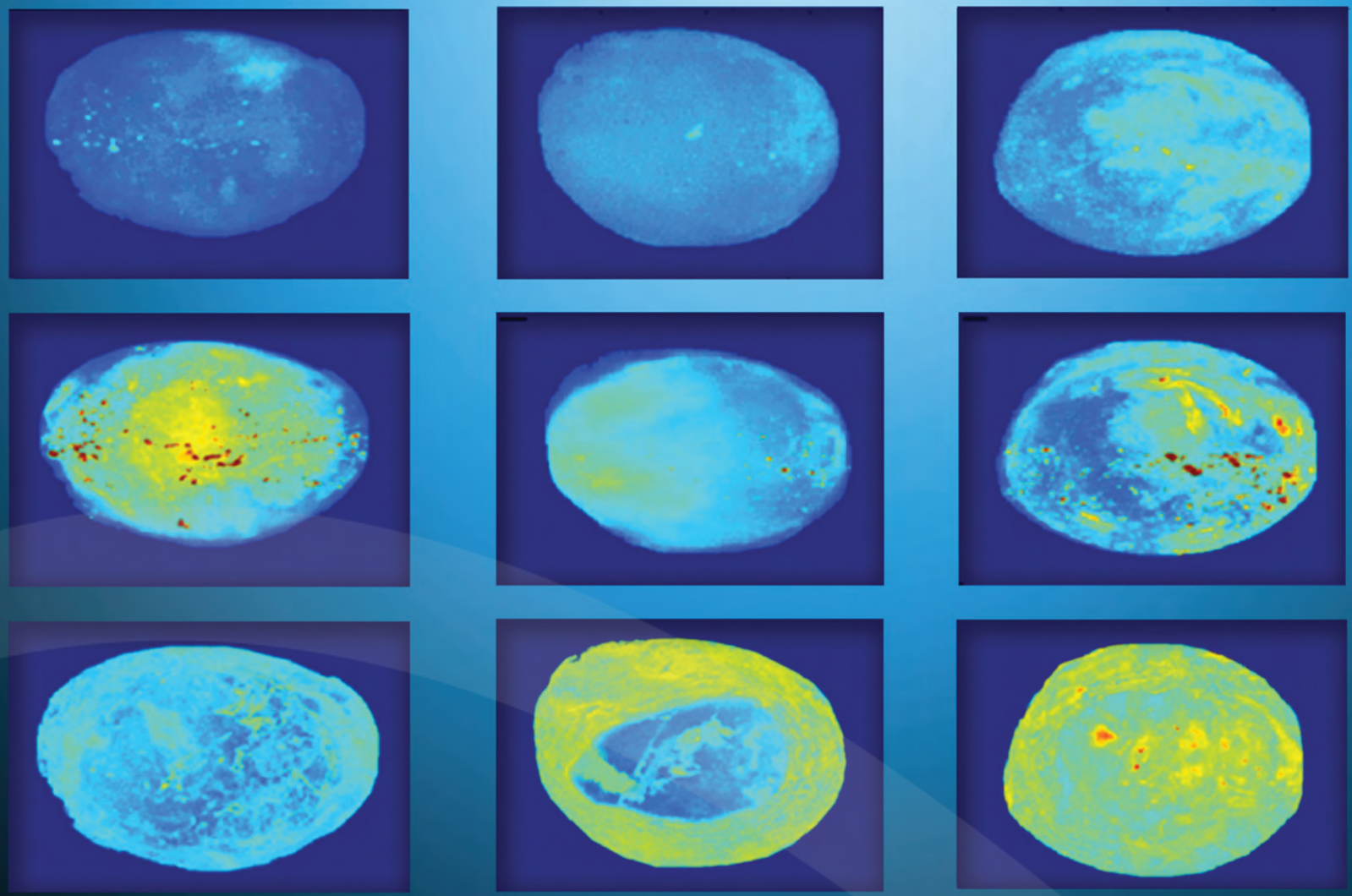
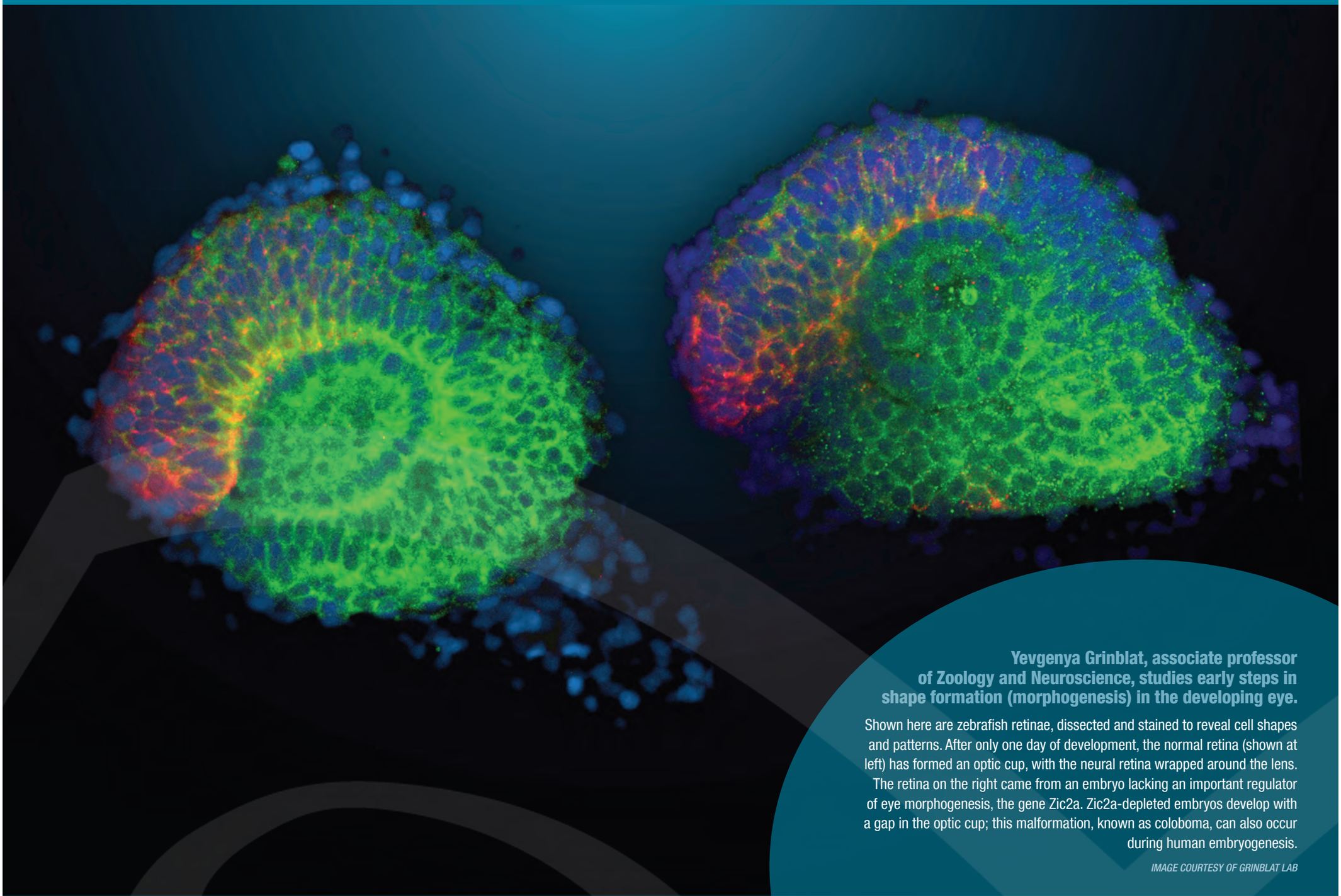


**Mitochondria, the energy factories within our cells that regulate cell life and death, play a key role in retinal health and disease.**

These retinal images from studies using a rat model show mitochondrial activity in normal retinae, mitochondrial dysfunction in retinae with retinitis pigmentosa, and renewal of normal mitochondrial activity/reversal of disease in retinae treated with light therapy. Investigations in the UW-Milwaukee laboratories of Janis Eells, professor of Biomedical Sciences, and Mahsa Ranji, assistant professor of Electrical Engineering, yield insights into the treatment of retinal degenerative disease.

*IMAGE COURTESY OF MAHSA RANJI AND JANIS EELLS LABS (UW-MILWAUKEE)*



**Yevgenya Grinblat, associate professor of Zoology and Neuroscience, studies early steps in shape formation (morphogenesis) in the developing eye.**

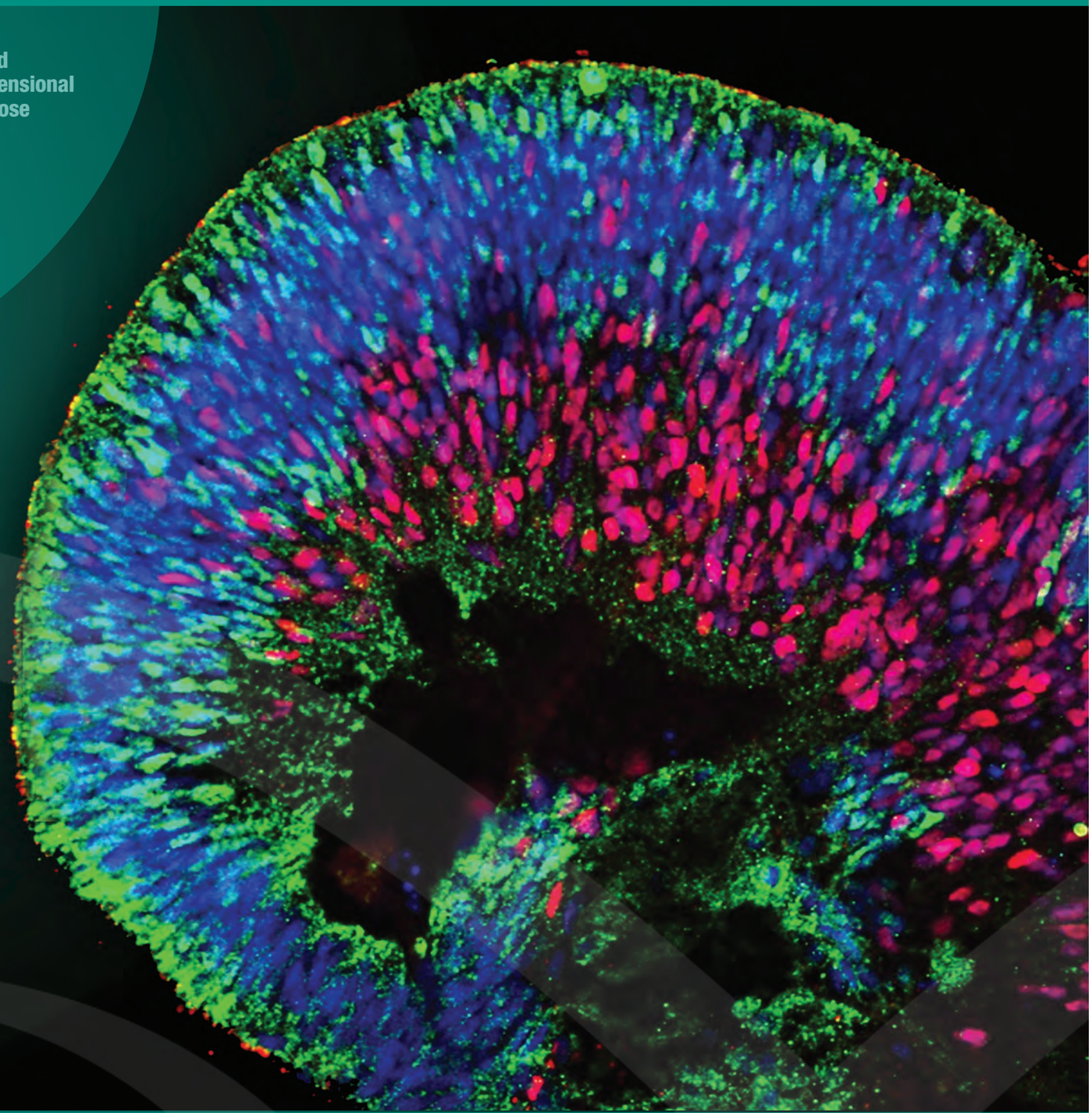
Shown here are zebrafish retinae, dissected and stained to reveal cell shapes and patterns. After only one day of development, the normal retina (shown at left) has formed an optic cup, with the neural retina wrapped around the lens. The retina on the right came from an embryo lacking an important regulator of eye morphogenesis, the gene Zic2a. Zic2a-depleted embryos develop with a gap in the optic cup; this malformation, known as coloboma, can also occur during human embryogenesis.

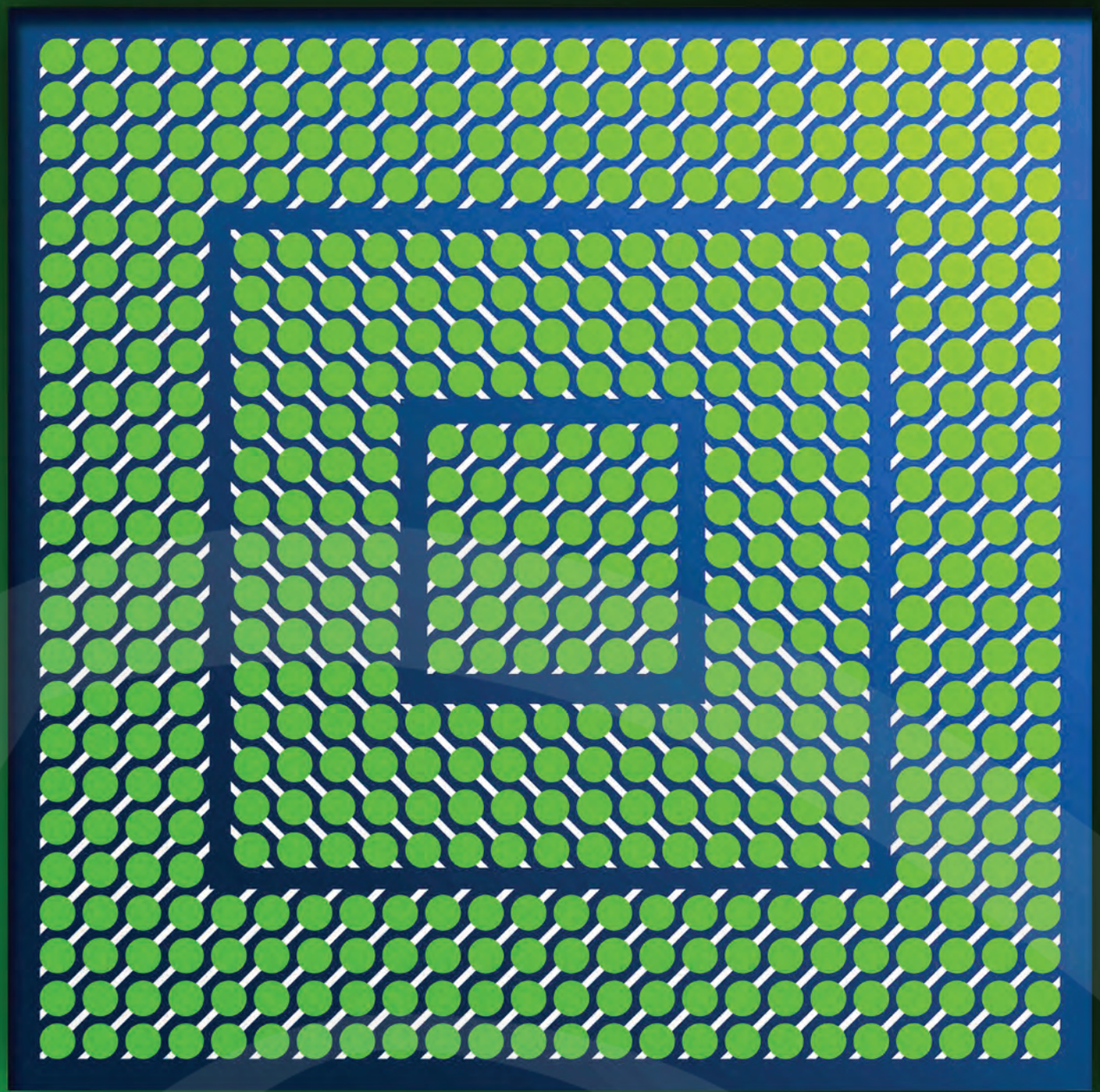
*IMAGE COURTESY OF GRINBLAT LAB*

**David Gamm, associate professor in Ophthalmology and Visual Sciences, uses stem cells to generate three-dimensional structures "in the dish" that are markedly similar to those formed in the developing eye.**

In this image, stem cells generated from reprogrammed human skin cells create an optic vesicle-like structure in which retinal cells at varying stages of maturation (depicted by red, green, and blue labeling) assemble into distinct layers highly reminiscent of the human retina in vivo. These structures can be used for studying retinal development, modeling eye diseases, testing therapeutics, and formulating retinal cell-based therapies.

*IMAGE COURTESY OF LYNDA WRIGHT, GAMM LAB*





**These nested squares constitute a variation on the Ouchi illusion, which is produced by orthogonally arranged lines of alternating light and dark regions.**

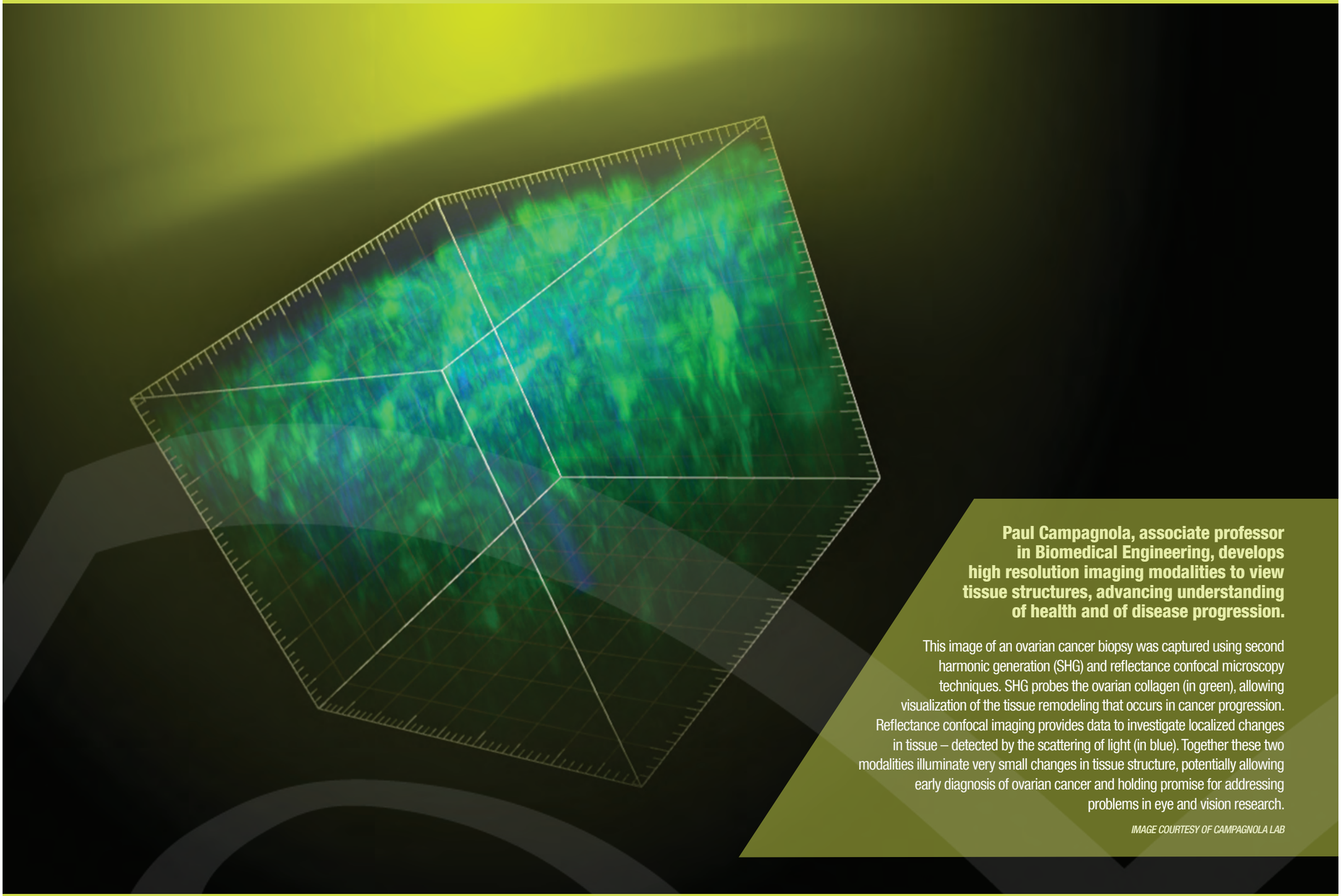
The illusion is the apparent motion of the center and surrounding squares relative to each other. Eye motion is required for the illusion to appear, and saccades – rapid unconscious eye movements – are generally sufficient. The illusion is most pronounced in peripheral vision, which is more sensitive to movement than central, fovial vision. Rodney Schreiner, researcher and educator in the department of Chemistry, focuses on the relationship between perception and underlying physical stimuli.

*SLIDERS, IMAGE COURTESY OF RODNEY SCHREINER*

**Curtis Brandt and Paul Kaufman, professors in Ophthalmology and Visual Sciences, are developing strategies to enhance gene delivery to the eye to treat glaucoma.**

Because natural defense factors in eye cells interfere with delivery of the therapeutic gene, they are exploring gene delivery aided by a drug that inhibits these defenses. These two panels show monkey eye tissue which has been exposed to a gene carrying a green fluorescent protein (GFP). In the left image, the GFP alone was delivered; in the panel at right, a defense-inhibiting drug was delivered with the GFP. The wider band of green fluorescence, along with its more even distribution in the drug-treated eye, suggests that more efficient delivery of a therapeutic gene can be obtained by overcoming the defensive factors in the eye.

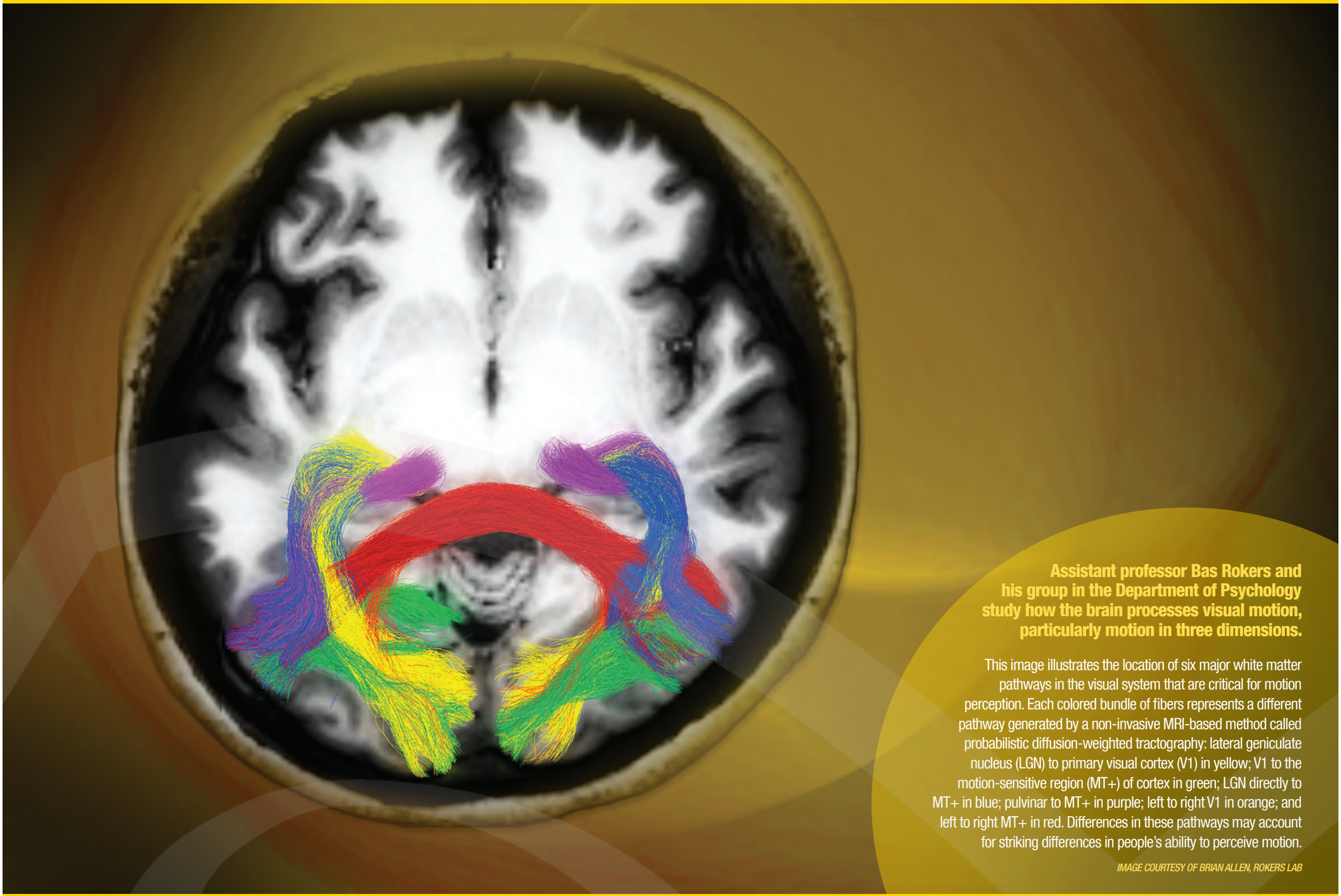
*IMAGE COURTESY OF ZEYNEP AKTAS, BRANDT LAB*



**Paul Campagnola, associate professor in Biomedical Engineering, develops high resolution imaging modalities to view tissue structures, advancing understanding of health and of disease progression.**

This image of an ovarian cancer biopsy was captured using second harmonic generation (SHG) and reflectance confocal microscopy techniques. SHG probes the ovarian collagen (in green), allowing visualization of the tissue remodeling that occurs in cancer progression. Reflectance confocal imaging provides data to investigate localized changes in tissue – detected by the scattering of light (in blue). Together these two modalities illuminate very small changes in tissue structure, potentially allowing early diagnosis of ovarian cancer and holding promise for addressing problems in eye and vision research.

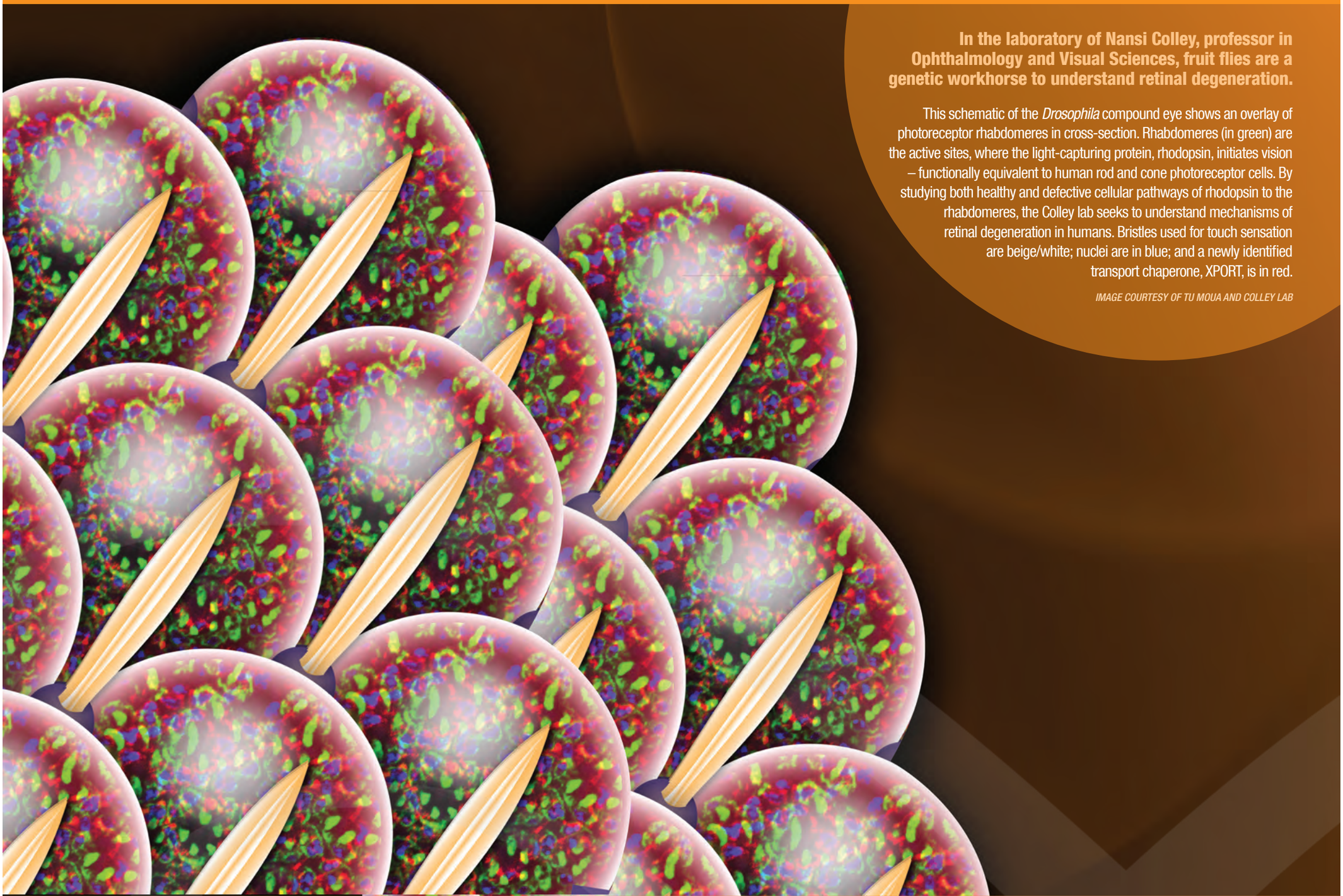
*IMAGE COURTESY OF CAMPAGNOLA LAB*



**Assistant professor Bas Rokers and his group in the Department of Psychology study how the brain processes visual motion, particularly motion in three dimensions.**

This image illustrates the location of six major white matter pathways in the visual system that are critical for motion perception. Each colored bundle of fibers represents a different pathway generated by a non-invasive MRI-based method called probabilistic diffusion-weighted tractography: lateral geniculate nucleus (LGN) to primary visual cortex (V1) in yellow; V1 to the motion-sensitive region (MT+) of cortex in green; LGN directly to MT+ in blue; pulvinar to MT+ in purple; left to right V1 in orange; and left to right MT+ in red. Differences in these pathways may account for striking differences in people's ability to perceive motion.

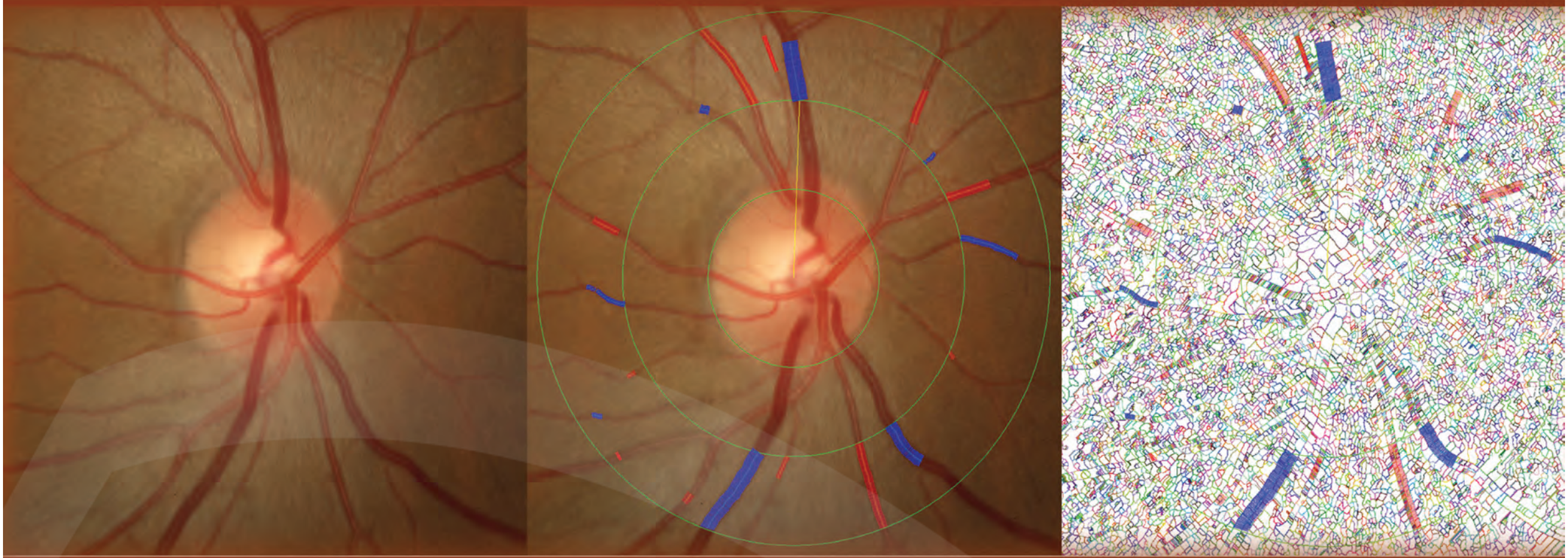
*IMAGE COURTESY OF BRIAN ALLEN, ROKERS LAB*



**In the laboratory of Nansi Colley, professor in Ophthalmology and Visual Sciences, fruit flies are a genetic workhorse to understand retinal degeneration.**

This schematic of the *Drosophila* compound eye shows an overlay of photoreceptor rhabdomeres in cross-section. Rhabdomeres (in green) are the active sites, where the light-capturing protein, rhodopsin, initiates vision – functionally equivalent to human rod and cone photoreceptor cells. By studying both healthy and defective cellular pathways of rhodopsin to the rhabdomeres, the Colley lab seeks to understand mechanisms of retinal degeneration in humans. Bristles used for touch sensation are beige/white; nuclei are in blue; and a newly identified transport chaperone, XPORT, is in red.

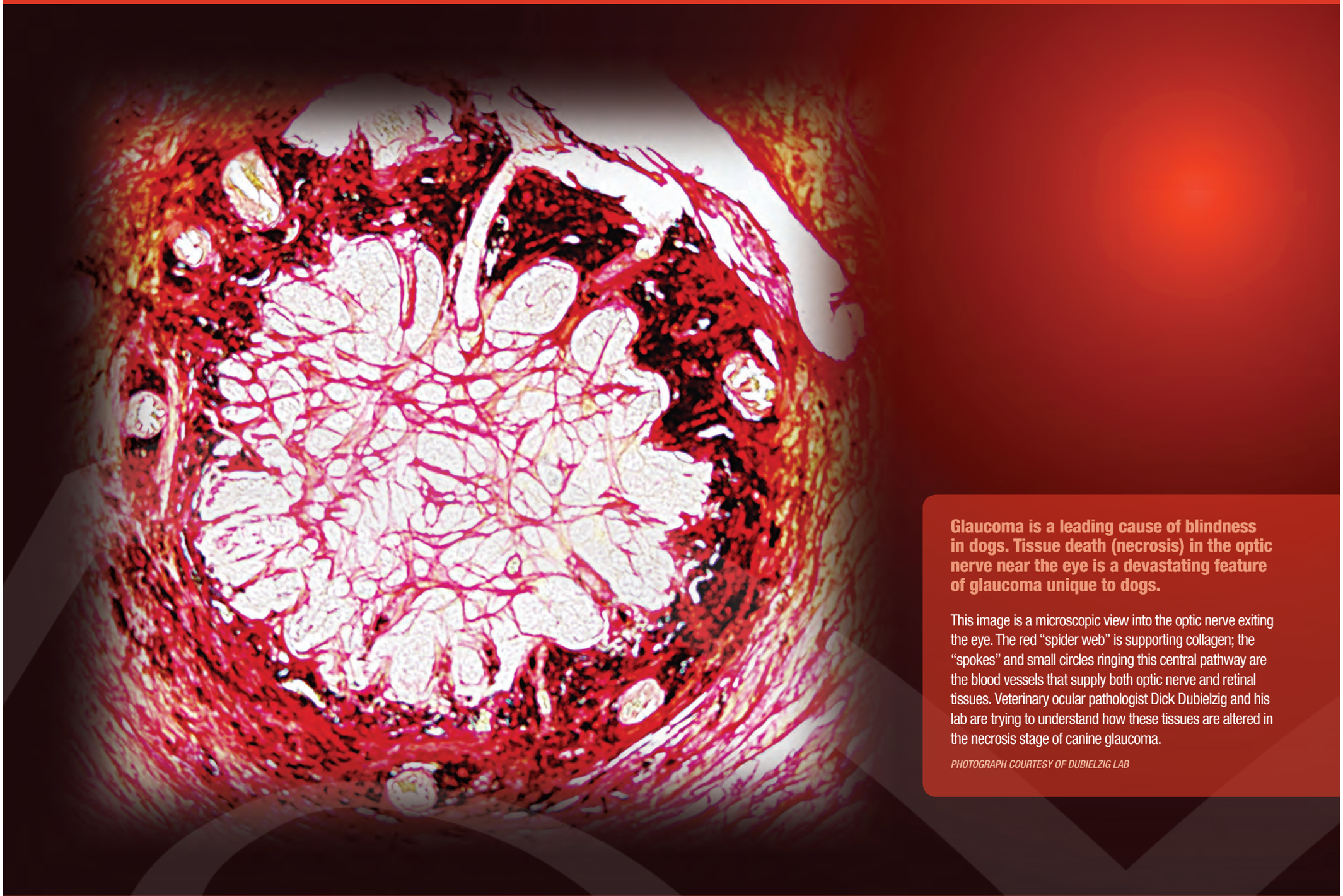
*IMAGE COURTESY OF TU MOUA AND COLLEY LAB*



**The image at left shows the small arteries and veins in the retina. The middle image shows computer-assisted measures of the diameters of these blood vessels, using red for arteries and blue for veins.**

Vessel diameters are then mapped by a computer program (on right). The Beaver Dam Eye Study, conducted under the direction of professors Ronald and Barbara Klein (Ocular Epidemiology Group), showed that study participants with diameter measurements of small arteries (narrower) and small veins (wider) in the retina have – independent of hypertension and other cardiovascular risk factors – increased risk of incident stroke and heart attack. These retinal vessel diameters, thought to be a measure of similar changes in the small blood vessels of the brain and heart, may be a valuable risk assessment tool.

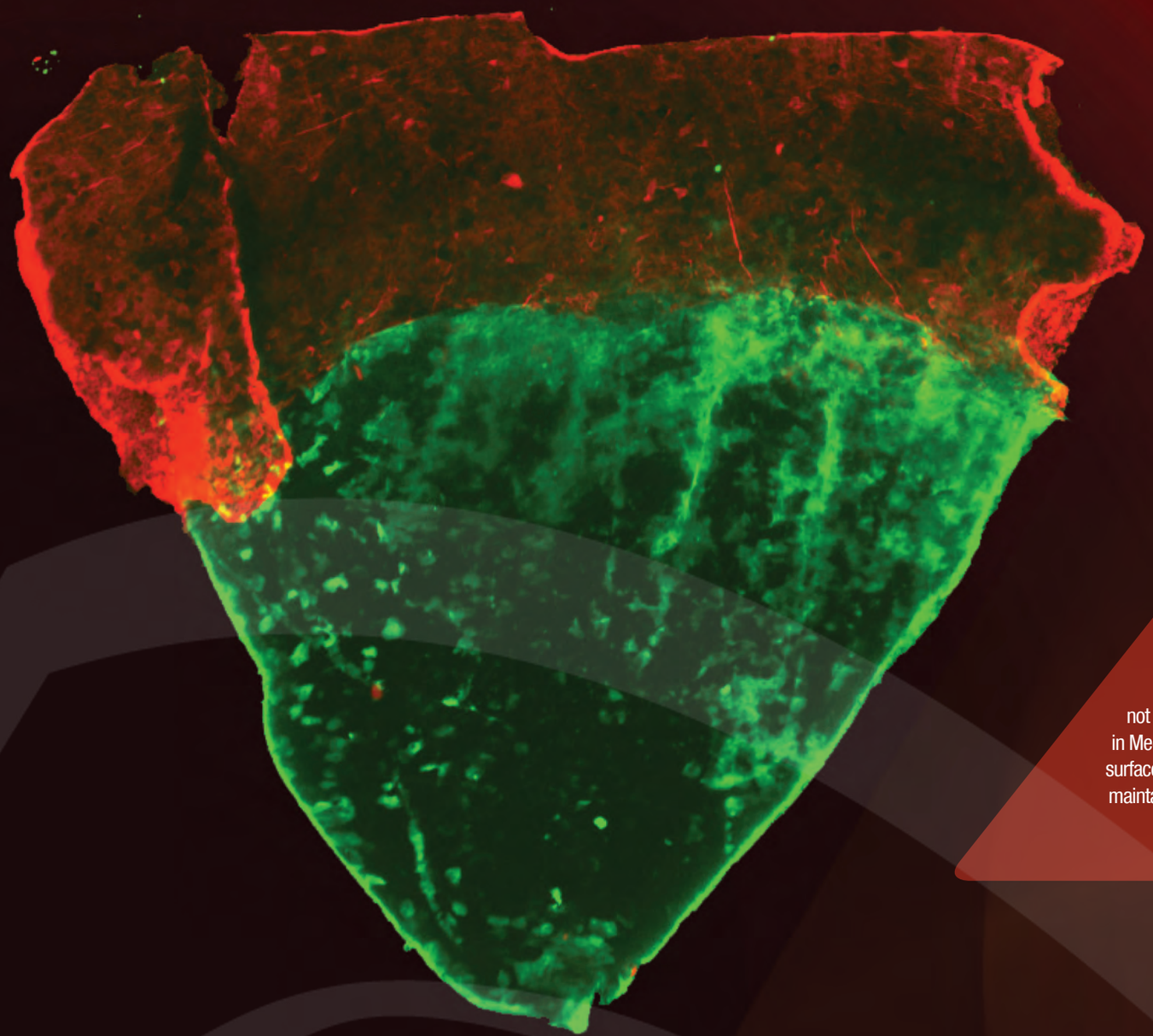
*IMAGE COURTESY OF DRS. BARBARA E. K. KLEIN AND RONALD KLEIN*



**Glaucoma is a leading cause of blindness in dogs. Tissue death (necrosis) in the optic nerve near the eye is a devastating feature of glaucoma unique to dogs.**

This image is a microscopic view into the optic nerve exiting the eye. The red “spider web” is supporting collagen; the “spokes” and small circles ringing this central pathway are the blood vessels that supply both optic nerve and retinal tissues. Veterinary ocular pathologist Dick Dubielzig and his lab are trying to understand how these tissues are altered in the necrosis stage of canine glaucoma.

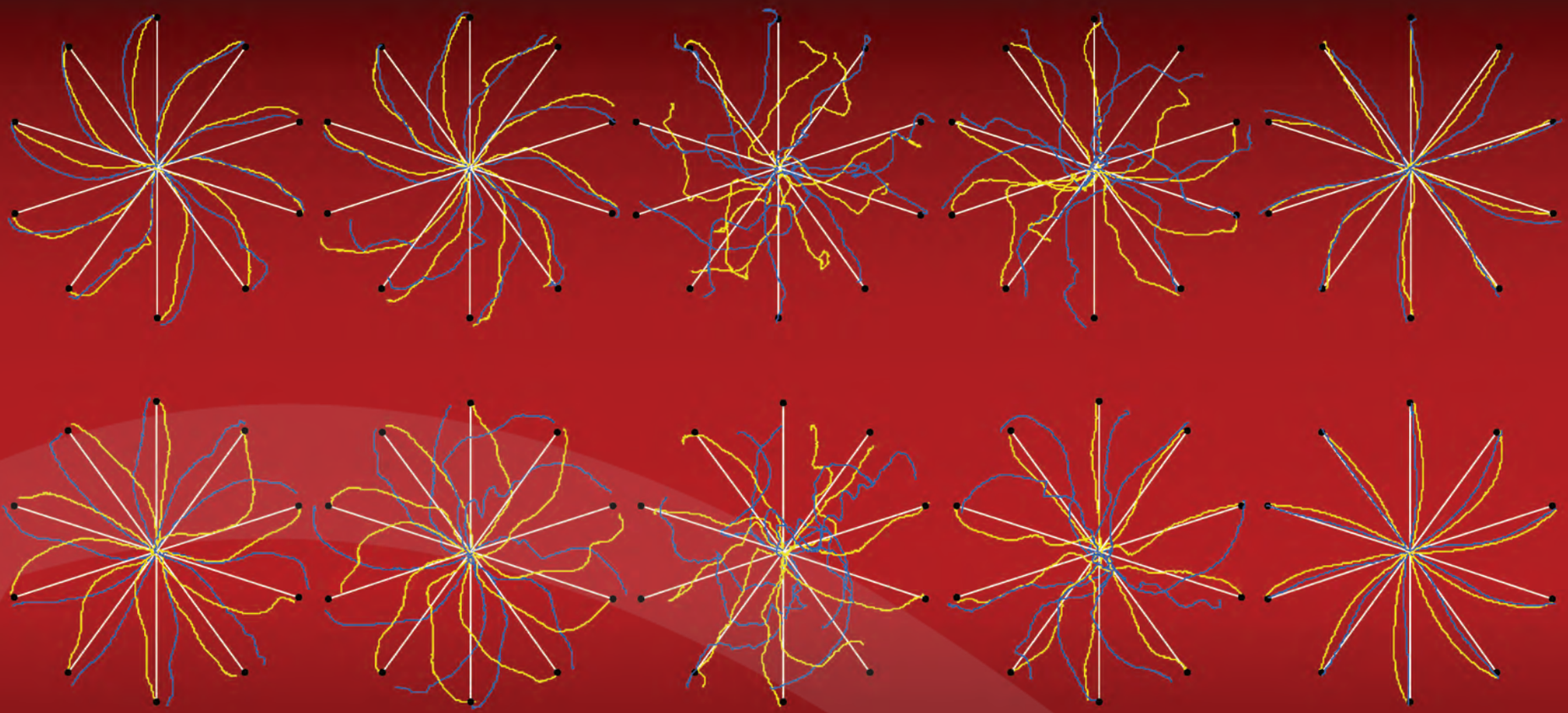
*PHOTOGRAPH COURTESY OF DUBIELZIG LAB*



**The corneal epithelium, the outermost corneal covering, has specific characteristics to serve as a protective barrier and smooth refractive surface for the eye.**

For example, it has a unique cytoskeletal molecule (green) that is not present in the neighboring tissue (red). Sakae Ikeda, associate scientist in Medical Genetics, studies a mouse model with irregular, thickened corneal surface to better understand how cellular integrity of the corneal epithelium is maintained to provide the smooth refractive surface needed for proper vision.

*PHOTOGRAPH COURTESY OF IKEDA LAB*



**Leigh Ann Mrotek, associate professor of Kinesiology at UW-Oshkosh, studies how the brain adapts to distorted visual information in order to plan, execute and correct hand movements.**

Resembling lovely snowflakes, these drawings show the paths traced by subjects when they try to intercept targets as visual feedback is progressively rotated. Yellow and blue lines represent different directions of rotation around the white, 360-degree framework. People in the yellow group received slightly more practice at each rotation, and their performance was markedly better. This indicates that the brain learns how to move in new environments very quickly, even in a difficult task where visual information conflicts with body feedback.

*IMAGE COURTESY OF MROTEK LAB*