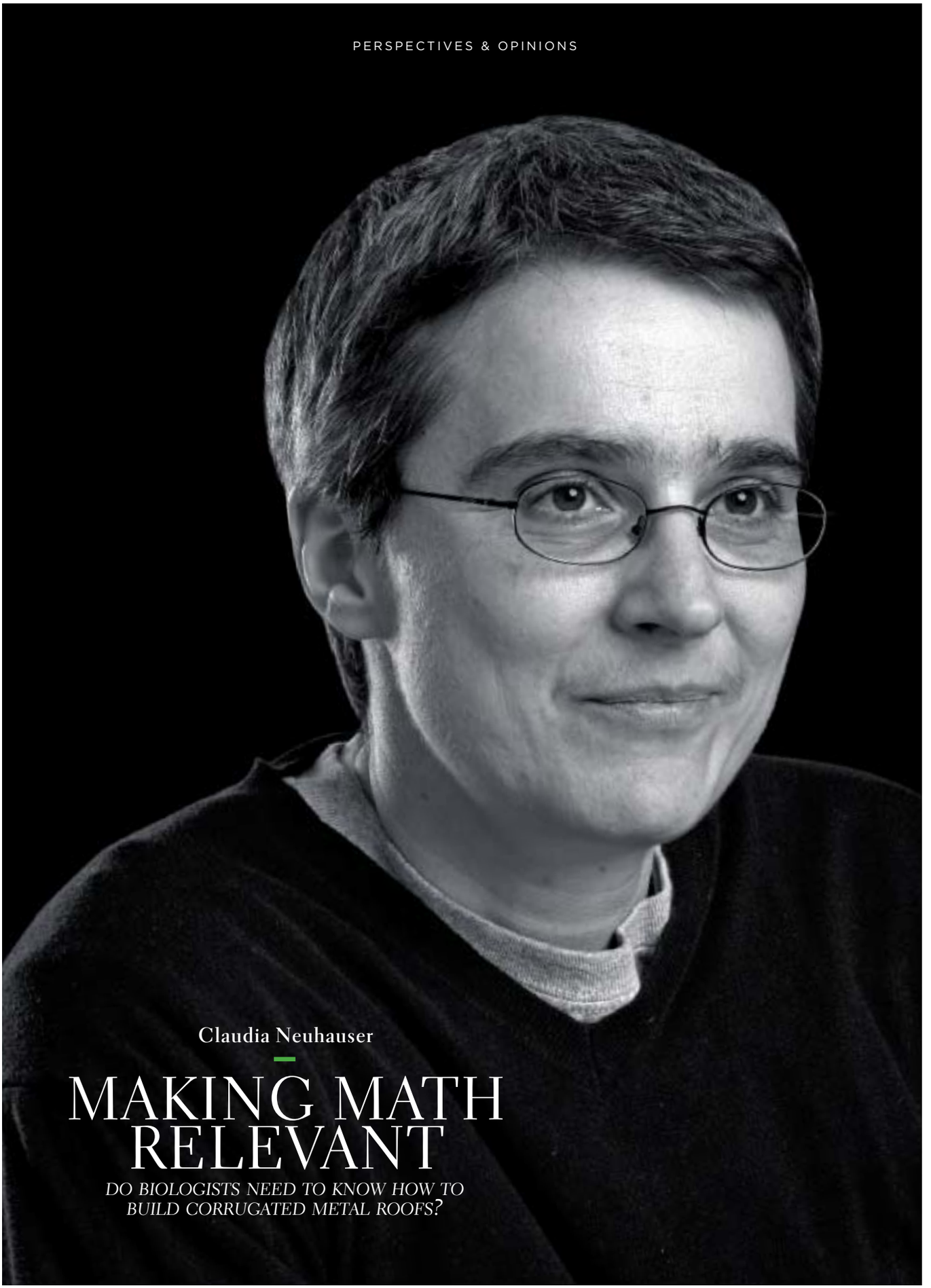

Claudia Neuhauser

MAKING MATH RELEVANT

DO BIOLOGISTS NEED TO KNOW HOW TO BUILD CORRUGATED METAL ROOFS?

John Christenson

Math education needs to adapt to the needs of future biologists, says Claudia Neuhauser, an HHMI professor at the University of Minnesota, Twin Cities. According to Neuhauser, biology students are often fed math designed for engineers—with little relevance to their field of study. Now, she's one of a number of faculty members around the country teaching her students quantitative skills within the context of biology.

What's driving the movement to revamp math education for undergraduates?

The math we teach biology students is not the math they need. First, the quantitative education we give them is often restricted to calculus, but the calculus we teach them is usually geared more toward engineering than biology. Second, biologists need to be able to sift through large data sets, but right now, we don't teach undergraduates data analysis. Today, we can sequence entire genomes, and we're developing networks of sensors that can continuously record things like temperature and moisture from the environment. These systems produce huge amounts of data, and to work with them students need a good grounding in statistical analysis and computer science tools like data mining.

However, I don't think we can just send them out to take a semester of computer science or a semester of statistics. We need to integrate these tools into the biology curriculum, because when you learn something in context, you can see its relevance immediately, and it sticks a lot better.

When did it hit you that students weren't getting what they needed?

When I first came to Twin Cities, I taught the first-year calculus course. The students just hated it; there was this sense of hostility in the classroom. So I asked, "Who am I teaching here?" It turned out the class was full of biology majors. We used examples like calculating the amount of material you need to build a corrugated metal roof, and the students had no idea why we were teaching them this stuff. So I designed a calculus course based on biological scenarios they may encounter later in school or once they graduate. The students got much more interested. After I did that, I started working with other faculty members to make math—especially data analysis—part of their own courses.

Can you give another example of making math relevant?

Fishing is big in Minnesota, and there is a differential equation that describes fish growth, used by some states' departments of natural resources to determine minimum catchable sizes. I used this sort of real-world system to teach differential equations in the calculus course.

Are other schools making similar changes in their courses?

There's been a shift at many schools toward focused calculus courses for biology students. Lou Gross at the University of Tennessee integrates data analysis and statistics into the first-year calculus course. He's been one of the driving forces behind the push for more statistics. In general, though, there has been much less done with data analysis than with calculus. I think part of the reason is that calculus is the traditional bedrock in the curriculum, and it's very hard to make the dramatic changes necessary to shift the focus to data analysis. Especially at large universities, courses are taught in different departments, and the faculty may or may not know each other. It's sort of a silo structure. You have to have a biology person and a math person or a computer science person sit down and decide they want to break out of the silos. It's a slow process.

Is there a quicker way to make it happen?

The best way is to create an integrated curriculum from the ground up. The big project I'm working on now is the health sciences major at our new campus in Rochester. Many of these students will go on to become doctors, dentists, nurses, and veterinarians. We're going to build a module-based curriculum, where the quantitative, life, and physical sciences and the humanities are taught in modules, and then students will have to combine what they learn in integrative lab courses. Biological information is increasingly stored in big, minable databases. It's going to be important for these students to be able to analyze those databases and do experiments based on the data.

Our goal is to give students the quantitative tools they'll need in 10 to 15 years, when they finish their schooling and take jobs. We know it's going to be a data-intensive world, and we know that the standard tools we currently teach them are not good enough.

INTERVIEW BY BENJAMIN LESTER. *Claudia Neuhauser, author of the textbook,* Calculus for Biology and Medicine *(Second edition; Prentice Hall), studies theoretical population biology.*