

Music to Students' Ears

In 2004 Prof Joe Wolfe was awarded two prestigious prizes in a fortnight. One of these was for research while the other was for teaching.

Wolfe is Professor of Physics at the University of NSW, specialising in the study of sound. However, his teaching ranges over many areas of physics, finding ways to explain concepts that frequently baffle students and can deter them from continuing their studies.

It was for this enthusiastic approach to education that Wolfe won the Physical Sciences and Engineering division of the 2004 Australian Awards for University Teaching. Wolfe created a course called "Physics Thinking" that, rather than simply teaching physics concepts, aims to get undergraduate students to think like a physicist.

Wolfe's regular physics classes were good enough that students nominated him for university awards in teaching, which led to the national prize. He says he enjoys "bringing the physics into his classroom" with numerous demonstrations. "It's great getting a whole lecture theatre talking about a demonstration."

Wolfe has also created an extensive set of web pages explaining the physics behind a lot of phenomena (www.phys.unsw.edu.au/~jw/teaching.html). He says "a lot of it is written for my students" but he also moderates a bulletin board on the NSW high school physics course, as well as providing web pages for those studying physics at school.

Some sites are designed to appeal to an audience with little physics background. Many musicians, for example, are interested in the acoustics of the instrument they play, and Wolfe has a large site to deal with many of their questions assuming very little background in physics.

"Musicians are an interesting audience because they are prepared to put

the effort in," Wolfe says. "They are not like the average web user. I get messages from people who have worked their way right through the whole site."

Wolfe's web site is also of interest to sports fans. Who could resist a link titled "the quantum mechanics of cricket" featuring a photo from a 1999 game against Zimbabwe when Australian captain Steve Waugh had all nine fielders in slips?

Wolfe says: "As soon as I saw the photograph I thought 'single slit diffraction', as this would be the perfect field if one expected the ball to diffract between bat and pad. He then set a homework problem based on the idea, and included the answer, with jokes, on the site.

Unfortunately, as Wolfe proves, in order to get quantum effects on an object the size of a cricket ball one would need to bowl at a speed of 3×10^{20} m/s. At such a slow speed, the Sun would have burnt out long before the ball travelled the length of the pitch.

Shortly after winning the teaching award Wolfe collected La Médaille Étrangère 2004 from the French Acoustical Society. This is awarded each year to honour a non-French scientist who has contributed to acoustics and has links with French acousticians. The award is for general achievement rather than a specific piece of work.

Wolfe says that his main contribution is that the lab he co-leads with John Smith "is really good at measuring acoustic response in noisy environments". This has produced world-leading research on the how musicians use their vocal tracts in singing and playing. Two spectacular examples are the projects on the didgeridoo (*AS*, August 2005, p.11) and on sopranos, including why they are so hard to understand when singing the high notes (*AS*, March 2004, p.13).



Wolfe says he was "one of those children who is always asking 'why?'" Why, he found, "often led to physics. Why is the grass green? Because of chlorophyll. Why is chlorophyll green? Because it absorbs certain frequencies of light, which led to quantum mechanics."

Wolfe says he got good answers as a child. "My father was a science teacher, and I had several teachers who pointed me to references including the *Encyclopaedia Britannica* article on space-time written by Einstein."

Becoming a physicist was certainly an option as a child, but it had competition, particularly from music. Wolfe is a wind player and composer. One of his strangest but best-known pieces is the *Stairway Suite*, commissioned by the UNSW Orchestra.

Inspired by Andrew Denton's TV show *The Money or the Gun*, which featured a different version of *Stairway to Heaven* in each episode, the orchestra sought an orchestral version. In the end Wolfe provided a suite of six variations on the song, each in the style of a different orchestral composer.

Despite this dual interest, Wolfe did not start out specialising in music acoustics, saying: "It didn't occur to me that it was possible". Instead, his early work was on the self-assembly of biomolecules.

"The main thing that holds molecules together in the nanostructure of the cell is the surface tension of water," Wolfe says. "I looked at what happens when you take away the water. Examples are seeds and plants in drought conditions, or frost damage and cryopreservation of cells and tissues." And yes, there was a medal for that work too.