PROFESSOR: Another part of the course is that I also have a project in the course. And students do the projects in pairs. Partly, because I just think it's nice for them to have somebody to work with. And they've done a huge range of projects. I let them do whatever project they want.

It has to have something to do with cellular solids. And some of them have done, sort of, analytical things where they've done numerical finite element analysis of some cellular structure. Some of them done very experimental things. And some have been a lot of fun.

So, for instance, almost every year there are students who want to work on food foams. And one year, for example, there was a group made bread. And they looked at sort of the processing of the bread. And they looked at how if you used more yeast, or you let the yeast rise, or the bread rise for longer, how that affected the cellular structures.

So they sort of changed the chemistry of how they made the bread. And then they looked at the micro structure of the bread that they got. I think they even did some mechanical tests of the bread. So that was kind of fun.

And I think, probably, the most interesting project any student has done was on elephants skulls. So you could imagine an elephant skull is huge, and it's bony. So it would be very, very heavy, if it didn't have some pores in it.

And elephant skulls, it turns out, have some very large pores in them. I think partly to reduce the weight of the skull, and the head, and the bone. The neck has to, kind of, carry it all.

So these two students came to me. And they said they had heard somewhere or they'd read somewhere that these pores in the elephant skull had an effect on how the elephants perceived sound and the acoustic transmission of sound waves through the skull. And they wanted to do a project on elephant skulls.

So I was kind of intrigued by this. I love all natural history kinds of things. And I've worked before with people at Harvard's Museum of Comparative Zoology, where they have bones. They have stuffed bodies. They have all kinds of animals over there.

And I called up a colleague over there, and it turned out they had elephant skulls over there. So I went with one of the students. And it was an attic of the building, this kind of dingy place. And there was this huge room. And it was full of elephant bones.

And they had several skulls, which are like the size of this table. They're huge. They're this big. And some of the skulls were cracked. And you could see these big pores in the skulls.

And then the students found out that University of Texas at Austin has CT scans, Computed Tomography scans of all sorts of bones. And sure enough, they had elephant skulls scanned. And so they got a three-dimensional representation of the elephant skull through this University of Texas at Austin program.

And then they used that as input to a 3D printing set up. So they 3D printed a sort of mimic of the elephant skull with some ceramic powder. And they made a skull was about this big. And then they wanted to look at the acoustic properties of it.

So what they did was they suspended the skull from a string. And they had a speaker, and the speaker had a sound. And they put an accelerometer on the skull. And they measured the vibration of the skull.

And then to compare it with the skull that didn't have these pores. And they got the CT image from Austin. And they 3D printed this dolphin skull. And they did the same thing. They suspended the skull from as a thread. And they measured the vibration.

And they could show-- and I've forgotten the details of their results-- but they could show, basically, that the two skulls had a different frequency response to the vibrations. And they thought maybe part of it was because the pores.

So these two sections here are two sections of their 3D printed elephant skull. I don't have the entire thing. But you can see this is the orbit, where the eyes would have gone in here. And if I turn it over and you look inside, you can see these pores in here.

And also if you look at this section lower down on the skull, you can see this whole porous structure here, as well. And if we flip it over there's a little bit more over there. So that was probably the most intriguing project that the students did as part of this course. That was quite something.