Exploring the territory in tissue engineering

A disagreeable side effect of longer life-spans is the failure of one part of the body — the knees, for example — before the body as a whole is ready to surrender. For decades, bovine collagen and other materials have been used for repairs, but it is now possible to use human material to restore damaged or worn-out tissue.

Tissue engineering, which occupies the fertile area between materials science and biology, has its roots in cell biology, immunology, chemistry and bioengineering, but it’s not uncommon to see apparently unrelated fields thrown together. Glenn Booma, a director of ‘outcomes research’ at the University’s centre for biologic nanotechnology, says that the cross-fertilization between disciplines is part of the fun. “You should be able to pick up some of the other specialty’s language, appreciate their issues and how they go about doing things.” The hardest thing for scientists to come to grips with, she says, is that a project does not depend solely on any individual’s work, even if it’s an outstanding achievement. “In a way, your fate is no longer in your own hands. That can be difficult to become comfortable with.”

Non-scientific factors can impinge on careers in a small company. Booma says that none who saw the seminal paper on cartilage defects in rabbits in 1984 would have dreamed it would take until 1997 to get approval from the Food and Drug Administration and commercialize their Carticel product. Now, however, investors do know, so even small companies with impressive technology platforms and good intellectual property may be bought up, as was his company was in 1994 when, as Biosurface Technology, it joined Genzyme. “Genzyme and Organogenesis have shown that tissue-engineering products are effective and marketable, but now we have to show that they can be profitable,” she says.

Those contemplating a career in tissue engineering should also be politically aware. Positive public attitudes translate into public support, whereas a negative impression can mean restrictive legislation, loss of funding and, in extreme cases, physical attacks on labs and personnel. Scientists should engage in discussion and clarify issues. Parenteau deplores the speculation that occasionally appears in the media as being harmful to the field and misleading and frightening to the public. Even preliminary or limited results can be misrepresented, raising false expectations for many and confusing the few for whom a breakthrough will truly bring help.”
companies themselves, which have to go out and raise money in order to survive, have a need to play up the bright side and not dwell unduly on the limitations,” Booma adds.

New university training programmes and faculty positions and public funding initiatives are good news for hiring trends.

In the United States, the National Institute of Standards and Technology’s Advanced Technology Program has funded product development in tissue engineering for the past two years with grants of $2–5 million. Last year the NIH set up a tissue-engineering working group, and may set up an institute. Says Gail Naughton, president of Advanced Tissue Sciences in La Jolla, California, “Tissue engineering used not to fit into any single category, but now the agencies are actually out there soliciting grant proposals. This is making a big difference.” She foresees career opportunities at various levels.

With growing institutional support, the outlook for the next 10 to 15 years is rosy. Improvements in technique and understanding will speed up progress. For example, Naughton thinks that the question of embryonic stem cells will be obviated by improvements in separations and culturing.

At the graduate level, BEH offers PhD degrees in bioengineering and toxicology. At the undergraduate level, there are minor bachelor degrees in both biomedical engineering and environmental health, and a mechanical engineering degree is in the planning stages. The goal of the graduate-level programmes is to define these disciplines, whereas the undergraduate programmes will connect traditional disciplines with problems and approaches in biotechnology and human health.

At the Georgia Institute of Technology (GT), a joint biomedical engineering department is being put together with the medical school at nearby Emory University. According to Nerem, the department will have space on both campuses, with two-thirds of faculty appointed through GT and one-third through Emory. Once appointed, they will act as a single department. A new PhD degree is going through the approval process, which will be a BME degree offered jointly by GT and Emory.

Over the next seven or eight years, Nerem estimates that GT will be hiring some 15 faculty. There are already seven faculty with primary appointments in the department, he says. They did not want simply to move the existing faculty into the new department. “I think it’s important that mechanical engineering at GT is still strong in biomedical research,” he says. A few of the faculty have moved into this new department, but most will be new faculty.

Generally speaking, Nerem thinks that “some of the best engineering students have an interest in biology and are excited about bioengineering”. Getting biology students interested in engineering is not quite so easy, he says. The problem, he explains, is that many people who do biology as an undergraduate shy away from quantitative courses. Too often biology majors do not study calculus or ordinary differential equations.

According to Lauffenburger, bioengineering is in the very early stages of development in terms of both its definition and the identification of career opportunities for its students. “I think that it’s a crucial challenge for us to help industry understand what we’re trying to accomplish with this education, and how people like this will be useful to hire alongside the chemical, mechanical and electrical engineers they have traditionally hired,” he says.