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Start small, think big

The United Kingdom and others must not overlook the potential for nanotechnology to boost regenerative medicine.

Andemariam Teklesenbet Beyene has benefited from a multidisciplinary approach to surgery. In June, the postgraduate student's cancer-riddled windpipe was replaced with one that had been created in a laboratory. Scientists at University College London created a glass replica of his trachea and two main bronchi, onto which they deposited layers of a porous polymer nanocomposite. Colleagues in Sweden soaked the structure in a solution of Beyene's bone-marrow stem cells to create a fully synthetic organ for transplantation. Windpipes have been replaced before, but Beyene's operation was unique in that no donor was required and there is no risk of rejection. The procedure was a triumph of cooperation, both between international researchers and between the physical and biological sciences.

Materials science has long been recognized as important in such advances. But the field's role is not confined to building biomimetic scaffolds for tissues and organs. The elasticity and surface topography of substrates can control stem-cell growth and differentiation, so materials research can help scientists to prepare cells for clinical use. And it can unravel the biological mechanisms that direct stem-cell behaviour.

Nanotechnology allows researchers to create materials with exquisitely fine structural detail, which are set to be increasingly useful in biology and medicine. Where surface structure and chemistry can be engineered to the cellular and subcellular level, scientists have unprecedented control in probing the responses of cells to their environment.

A paper in this month's *Nature Materials* reports a nanostructured substrate that can maintain stem-cell viability and allow cells to grow for eight weeks (R. J. McMurray *et al. Nature Mater.* **10,** 637–644; 2011). Cells cultured on these surfaces provide insight into the biomolecular factors that control cell-signalling pathways.

But high-profile success of clinical work using tissue scaffolds could draw attention, and funding, away from such fundamental contributions. This may already be happening, at least in Britain. In July, just over a week after news broke of Beyene's operation, the UK government's Office of Life Sciences published a report called *Taking Stock of Regenerative Medicine in the United Kingdom*. It recognizes that research in the physical sciences is needed to move regenerative medicine from the laboratory to the clinic, and notes that new materials, diagnostics and imaging are needed. But it frames useful materials research solely in terms of engineering scaffolds for delivery and application.

In doing so, the government misses an opportunity to outline a remit to investigate materials and the way they control stem cells. Such an approach would help biomedical engineers to design scaffolds and matrices with cell behaviour as a priority, rather than an afterthought.

And although the paper in *Nature Materials* and the engineered trachea (both UK-based research efforts) show that nanotechnology is important to all areas of regenerative medicine, the word nanotechnology does not feature once in the report's 58 pages.

The United Kingdom has no ongoing funding programme that specifically focuses on nanotechnology. In July, Cientifica, a nanotechnology consultancy based in London, released an assessment of global spending in the field that placed Britain almost last, just above India. Richard Jones, a former nanotechnology adviser to the UK Engineering and Physical Sciences Research Council, argues on his blog that Britain has given up on nanotechnology (go.nature.com/xxoy9x).

To help to reverse the trend, scientists, universities and funders should highlight research areas in which nanotechnologists can contribute to scientific success. Regenerative medicine offers such an opportunity. ■

Keep it clean

Integrity guidelines are a good start, but they must be clear and appropriately enforced.

Maintaining integrity in science seems to be in fashion. US officials are preparing to review policies on scientific integrity drafted by some 19 government agencies. Canada is overhauling its research-integrity policy, and the UK Research Integrity Office is looking for new sources of support after losing government funding. The European Commission has also started to discuss how to include scientific integrity in its research framework agreements.

The US policies will apply not only to agency scientists, but also to political appointees, managers and public-affairs officials. This broad scope is deliberate and intended to avoid a repeat of the alleged abuses of science that occurred under the administration of former US President George W. Bush (see page 262).

Still, to frame such policies so broadly does bring potential trouble — how should officials apply them to scientists? Vague requirements, such as to approach research objectively and to welcome constructive criticism, are good professional codes of conduct — but they must not be interpreted as a stick with which politically conscious managers can beat scientists to suppress inconvenient scientific findings.

It would be too easy for officials to violate the intended spirit of a loosely worded scientific-integrity policy by claiming that scientists had violated the letter of it. The United States classifies scientific misconduct as falsification, fabrication or plagiarism, and the broad concept of integrity must be coordinated carefully with that narrow definition. And, of course, good policies are not enough if they are not implemented wisely. To that end, US federal agencies must continue to improve their practices through training for managers of scientific staff, and ensure that they turn to the proper scientific expertise when misconduct is alleged. ■