

The scientist of the future

Susan Greenfield and **Martin Westwell** from the Institute for the Future of the Mind consider the needs of the future scientist.

Author,
Susan Greenfield

Think for a moment of all the scientific and technological developments in recent years, and about the prediction that new innovations will be introduced with increasing frequency: surely we should consider what the scientists of the future will need?

As developments in communication technologies make information even more accessible, scientists are in danger of drowning in a sea of irrelevant reports that range from scientific data to folklore. Future scientists will need the skills not only to transform information into knowledge, but also to select which information to consider.

In this century, the Internet is likely to continue to be one of the main sources of information for scientists. Despite the ubiquitous nature of the Internet and the general acceptance that it is important (according to 82% of pupils and 73% of people of working age), a substantial proportion of





Author,
Martin Westwell

the population (30% of 9-19 year-olds) have received no lessons on using the Internet (Dutton et al., 2005). In fact, only one-third (33%) of those children who are daily and weekly users have been taught how to judge the reliability of online information, whereas 38% trust most of the information on the Internet (Livingstone & Bober, 2005).

There seems to be a gap between the information processing abilities and skills that will be required by the scientists of the future and the education that they receive. As the world changes we need to ask ourselves an important question: what is science education for?

The first purpose of school science education should be to give the next generation of citizens who choose not to continue their formal science education the means by which to understand science and how it works. Each individual should be given the tools to appreciate how real-world science affects them and how they might form their own opinions on issues of science and technology. Some existing and planned courses help to meet this need, such as the UK's Nuffield^{vi} AS qualification (ages 16-18) in 'Science for the Public Understanding', with a full A-level qualification (also for ages 16-18 but with more detail than the AS) being considered for introduction in September 2008.

But how can we teach the way that science works? Think about what

happens in a class experiment to determine the boiling point of water. One thing is certain: almost no-one will achieve 100 °C unless they already know the answer and are trying to please the teacher. Skip will get 102 °C, Tania will get 105 °C, Johnny will get 99.5 °C, Mary will get 100.2 °C, Zonker will get 54 °C, while Brian will not quite manage to get a result; Smudger will boil the beaker dry and burst the thermometer. Ten minutes before the end of the experiment, the results are gathered: Skip had his thermometer in a bubble of superheated steam when he took his reading; Tania had some impurities in her water; Johnny did not allow the beaker to come fully to the boil; Mary's result showed the effect of slightly increased atmospheric pressure above sea-level; and Zonker, Brian and Smudger have not yet achieved the status of fully competent research scientists. At the end of the lesson, each child will be under the impression that their experiment has proved that water boils at exactly 100 °C, or would have done were it not for a few local difficulties that do not affect the grown-up world of science and technology, with its fully trained personnel and perfected apparatus. And yet that ten minutes renegotiation of what really happened is the important part; by reflecting upon that ten minutes, the class could learn most of what there is to know about

how science works (Collins & Pinch, 1993).

The second purpose of school science education is to reach that small proportion of students who go on to higher education in science and/or to work in science and technology. For them, building a foundation of basic knowledge and an understanding of a scientific approach is important.

However, in a changing world, this necessary foundation will not be sufficient.

Modern-day and future science will increasingly demand specialised proficiency from scientists, coupled with an ability to work with other scientists outside their own expertise. A natural consequence of this specialisation within interdisciplinary teams is that future scientists will have to rise to the challenge of explaining their science in ways that other scientists and non-scientists can understand. Chemists will have to engage with psychologists, molecular biologists with nanotechnologists, and neuroscientists with economists, until the edges between the disciplines are blurred. Even with the introduction of new technologies, communication and interpersonal skills will be more important than ever.

The future scientist will have to go a step further and engage with wider society if science and technology are to maintain their place at the heart of modern culture. The majority of peo-

ple who did not pursue a science education will look to the minority to help them make decisions and formulate opinions. However, the enthusiastic scientist will have to take this responsibility seriously – it is not about telling people what to think.

Professor Ian Diamond, the Chair of Research Councils UK, recently said that although a survey (MORI, 2005) showed that more than 80% of adults think science makes a good contribution to society and that science will make our lives easier, we should be doing more to increase this number. The future scientist will be required to play a part in ensuring that everyone in society is adequately engaged in science. Non-scientists should be able to contribute to scientific debates with confidence in their opinions, whether or not they agree that science makes a positive contribution to society. The integration of science with wider society and future culture is crucial for our social as well as economic development, and this integration starts at school.

In a shrinking world, science is becoming ever more global and this international community of scientists will be pivotal if we are to seriously address worldwide problems such as climate change and disease. Yet, in this globalisation of science there is a danger that we are dividing into worlds of technological 'haves' and 'have-nots'. Through initiatives such as the Science Corps^{w2}, the scientists of the future will be able to use their skills and abilities to apply science and technology to problems in both the developing and developed worlds.

The scientist of the future will need to be equipped to ask the right questions and to find the right answers.

References

Collins HM, Pinch T (1993) *The Golem: What Everyone Should Know About Science*. Cambridge, UK: Cambridge University Press

Dutton WH, di Gennaro C, Hargrave AM (2005) *The Internet in Britain: The Oxford Internet Survey (OxIS)*. Oxford, UK: Oxford Internet Institute. www.oii.ox.ac.uk

Livingstone S, Bober M (2005) UK *Children Go Online: Final Report of Key Project Findings*. London, UK: UK Children Go Online. www.children-go-online.net

MORI (2005) *Science in Society: Findings from Qualitative and Quantitative Research*. London, UK: Office of Science and Technology, Department of Trade and Industry. www.mori.com/polls/2004/ost.shtml

Web references

w1 - The Nuffield Foundation 'Science for Public Understanding' website: www.scpub.org

w2 - The Science Corps: www.sciencecorps.info

Baroness Greenfield CBE is Director of the Royal Institution of Great Britain (the first woman to hold that position) and Professor of Pharmacology at the University of Oxford, UK, where she leads a multidisciplinary team investigating neurodegenerative disorders. In addition she is Director of the Oxford Centre for the Science of the Mind, exploring the physical basis of consciousness, and of the Institute for the Future of the Mind, UK.

Her books include *The Human Brain: A Guided Tour* (1997), *The Private Life of the Brain* (2000), and *Tomorrow's People: How 21st Century Technology Is Changing the Way We Think and Feel* (2003). She has started four companies based on her research, made a diverse contribution to print and broadcast media, and led a Government report, *Women In Science*. She has received 28 honorary degrees, an honorary fellowship of the Royal College of Physicians (2000), a non-

political life peerage (2001) as well as the Ordre National de la Legion d'Honneur (2003). In 2006 she was installed as Chancellor of Heriot-Watt University, UK, and voted Honorary Australian of the Year.

Dr Martin Westwell is Deputy Director of the Institute for the Future of the Mind at Oxford University, UK, determining how we can harness new technologies to maximise the potential of all individuals and safeguard their individuality. Martin received his degree and PhD in organic chemistry from Cambridge University and then moved to Oxford as a research fellow where he discovered neuroscience, the biotech industry and a number of science and society projects including the Café Scientifique. His awards as a science communicator include being named Scientist of the New Century in 1999 by *The Times*/Novartis.

