expertise, including some of its own expatriate scientists. International academic bodies can help considerably both in the development of a country's science policy and in the building of its institutions – organizations such as TWAS, the academy of sciences for the developing world, the International Council for Science (ICSU) and the InterAcademy Panel (IAP). In particular, they can help establish the necessary high standards and effective organizational structures.

Once a national science strategy is up and running, then science can start to inform public decision-making – a crucial role in developing economies. Many public policy issues can only be properly resolved with in-depth knowledge and science-based analysis – questions such as which form of energy to use, how to increase agricultural production, how to protect the environment and improve public health. It is essential that national academies actively participate in national and international debates on these and other issues, not only to inform the debate but also to make the voice of science heard.

In addition, it is important to promote the "values of science" that effectively allow the pursuit of research to flourish. These include: rationality, creativity, the search for truth, adherence to codes of behavior and a certain constructive subversiveness. Science requires freedom: freedom to enquire, to challenge, to think, to imagine the unimagined. It requires tolerant engagement with the contrarian view, accepting to arbitrate disputes by the rules of evidence and rationality. The content of the scientific work is what is discussed, not the person who produced it, regardless of the color of their skin or the god they choose to worship or the ethnic group they were born into or their gender. These are societal values worth defending, not just to promote the pursuit of science, but to have a better and more humane society.

After policy, the second key task to building a national foundation in science and technology is to improve the quality of teaching, especially in science and mathematics, from pre-school through to graduate studies. This is less about building a curriculum and training teachers, important as these are, and more about communicating to children the enormous adventure of discovery inherent in the scientific enterprise. It is about teaching them to appreciate the elegance and beauty of mathematics, and helping those who are interested in the subject to realize their potential. It is about engaging people with the quest for knowledge.

One mistake that many developing nations have made when trying to improve education is to focus on increasing the length of time students spend in education while failing to address the quality of learning. Governments tend to believe that the longer someone spends studying, the more they will ultimately contribute to the national drive for economic development. However, recent long-term studies by the World Bank and others show that increasing the number of years in education has only a limited effect on promoting economic growth, while improving the quality of the education has a markedly positive effect.

Another educational challenge is to reform universities – a vital task. The university is an engine of modernization and change in any society and an enormous force for progress. Its social and political roles are as important as its scientific and technological ones. Many universities in the developing world today are still relying on rote learning of fixed curricula and following an apprenticeship model in their graduate studies. Reform is badly needed. Greater recognition must be given to the possibilities of self-learning and guided learning (such as distance-learning) and not just formal instruction based on student-teacher interaction in classrooms.

Governments in developing countries will need to address the "brain drain" of their talented youths to more promising futures and lucrative careers in the advanced industrialized countries. They will also have to find ways to attract larger numbers of talented persons, including women and minorities, into the sciences, and then try to retain them in these fields. They can organize effective joint training with the universities in the advanced countries where the topics of research would be more applicable to developing country needs, and where part of the work could be done in the home country. In addition, the returning graduate students should be supported by special grants and the possibilities of working in better laboratories. However, some emigration is unavoidable as an aging North will draw on the younger South to staff its hospitals and its institutions. So developing country governments have to turn "brain drain" to "brain gain" by building constructive links with the expatriate scientists, doctors and engineers that are likely to lead to collaborative research, itself an important factor in building a strong scientific base for R&D in the developing countries.

For successful development, countries need more than good schools and universities: they need "centres of excellence", institutions dedicated to cutting-edge research and training in science, medicine, agriculture and engineering.

Centres of excellence are the key to innovation; their importance cannot be overestimated. Every developing country will need one to help it grow its capacity in science and technology. The centres will need to be autonomous, with capable leadership and sustainable financial support, and will need to have focused research agendas. Each new research project should be funded competitively, decided by expert review, and evaluated on both its technical merits and its potential benefits to society. The review panels should ideally include appropriate experts from other nations.

An important step is the creation of so-called "virtual networks of excellence" (VNEs), which link geographically distant research groups and institutes across the nation and the developing world via the internet, allowing them to work collaboratively, nurture scientific and engineering talent, expand by pooling available academic resources and share expertise. Such VNEs, however, require at least one real "bricks and mortar" institute or centre of excellence to act as as an anchor for the network. Successful examples of VNEs are the research networks created in several countries by

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Air pollution is a global problem with local solutions

Air pollution is a serious problem in cities across the developing world. There are, however, examples of cities that have taken advantage of existing technologies to partially mitigate the problem. With 20 million people, Mexico City is the world's second largest city after Tokyo. It is also situated in a valley where polluted air tends to become trapped. As a result, it has long suffered from pollution problems that have adversely affected public health. Mexico City's health problems became so acute in the 1990s that they prompted the government to take action. Emission standards were set and vehicles were required to undergo inspections twice a year. In addition, new vehicles had to be equipped with catalytic converters that significantly reduce noxious tail-pipe emissions. Leaded fuel damages catalytic converters; so, the introduction of catalytic converters also led to the widespread use of lead-free gasoline. Motor vehicles produce three-quarters of Mexico City's air pollution. As a result, the measures taken have created noticeable improvements in air quality. In China, where large cities also suffer from excessive air pollution, the situation is different. A larger portion of the air pollution is due to emissions from power plants and industrial facilities. Technologies also exist to curb emissions from these sources; however, power plants and industrial facilities drive economic growth in China, where, for example, one new coal-fired steam plant is being added to the electric grid every 7–10 days. The Chinese government made an enormous effort to improve air quality in Beijing for the Olympics. We can only hope that this effort will spread to other cities as well.

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