Priority Area Assessment on Capacity Building in Science

Strengthening international science
for the benefit of society

ICSU
International Council for Science

About ICSU

Founded in 1931, the International Council for Science (ICSU) is a non-governmental organization representing a global membership that includes both national scientific bodies (101 members) and international scientific unions (27 members).

ICSU's extensive membership network constitutes an international forum for scientific research and policy development.

In broader terms, because of its representative and diverse membership, the Council is increasingly called upon to speak on behalf of the global scientific community and to act as an advisor in matters ranging from ethics to the environment.

CSPR

The Committee on Scientific Planning and Review was established in 1998, to coordinate the development of proposals for major new scientific initiatives by ICSU and to advise the Executive Board on priorities for such initiatives.

The Committee also reviews the activities carried out by ICSU 's Interdisciplinary Bodies, advises the Executive Board on the future course of these activities, and oversees the ICSU Grants Programme. The CSPR 's terms of reference can be found under Rule of Procedure 11.1a) at: www.icsu.org – infocentre//ICSU central.

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Priority Area Assessment on Capacity Building in Science

Report of the CSPR Assessment Panel

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Preface

As part of a strategic planning exercise, the ICSU Committee on Scientific Planning and Review (CSPR) commissioned three Priority Area Assessments (PAA); Environments and its Relation to Sustainable Development, Scientific Data and Information, and Capacity Building in Science. A number of eminent scientists were invited to produce a report outlining their vision for developments in the area of the PAA, to review ongoing activities of the ICSU family and on the basis of an analysis of the identified needs and the existing spectrum of activities, propose action that ICSU might wish to take.

The current report is the result of the deliberations of the Panel charged with addressing Capacity Building in Science. The Report is that of the Panel and the conclusions do not necessarily reflect those of the CSPR or the ICSU Executive Board. The many recommendations have been very valuable in defining the ICSU Strategic Plan, which was adopted at the 28th General Assembly of ICSU (October 2005). Based on the discussions at, and decisions by, the General Assembly, the CSPR and the Executive Board will continue to consider the recommendations of the report and develop new initiatives to ensure that ICSU plays a prominent and appropriate role in this area. Capacity building is a basis for almost all of ICSU's activities. The PAA report will help us focus our attention on still untapped potentials within the ICSU family.

Thomas Rosswall
Executive Director

Executive Summary

The Committee on Scientific Planning and Review (CSPR) of ICSU appointed a Panel to conduct a Priority Area Assessment (PAA) of Capacity Building in Science. This is the third PAA to be conducted, the other two having dealt with "Environment and its Relation to Sustainable Development" and "Scientific Data and Information." These assessments have been carried out as part of a process to define an ICSU strategy for 2006-2011.

As a point of departure, the Panel took the report from the InterAcademy Council (IAC) "Inventing a Better Future. A Strategy for Building Worldwide Capacities in Science and Technology" (http://www.interacademycouncil.net/report.asp?id=6258). The Panel calls attention to three crucial challenges to building scientific capacity. These challenges underlie the Panel's rationale for focusing on efforts to make capacity building in science a global priority, to build and strengthen human capital, to communicate between science and society, and to strengthen the links among education, research, and society.

The first challenge, a development problem, is the widening gap between advancing scientific knowledge and technology and society's ability to capture and use them. This is not just a question of the digital divide, since access to information is not necessarily equivalent with having knowledge. Introducing science and technology to a world with diverse experiences is one barrier to overcome. The expanding use of knowledge in developed countries, as developing countries continue to lag behind, is another. Better communication of science to the public will help transcend the diversity of experiences, and enable constructive dialog about the risks and benefits of scientific discoveries and new technologies. Closing knowledge gaps will require developing national strategies for science and technology development that are linked with effective policies. There is a need to build national innovation systems. Science is also an important basis for sound decision making in many sectors of society. International science and technology cooperation and exchange also play a critical role in narrowing knowledge, information, and technology gaps between countries and societies.

The second challenge, a workforce problem, is the apparent declining interest in the study of science and engineering around the world. Recruiting talent into science will continue to be a concern unless educators and scientists find better ways to teach science and mathematics at all levels, in ways that "turn on" students early and often, rather than "turn off" interest in science. Attracting, developing, and retaining talent in science and technology should be a priority of the scientific community in all fields. Over the past decade, the international scientific community increasingly has made focusing attention on science education at all levels a priority, and has identified this as one of the critical challenges to strengthening human resources. The issues include improving the quality of science education; teacher training; science curricula; and testing, evaluation, and assessment; as well as expanding the number of educators and the links between formal and informal education. Because of the role that women play in society, special emphasis should be placed on encouraging more women to enter careers in science. Better and more uniform testing, evaluation, and assessment are needed to keep abreast of what works and what does not work in efforts toward improvement and reform, as well as more effective forums for sharing experiences in science education and educational-reform movements.

The third challenge, an institutional problem, is the need to turn knowledge consumers into knowledge creators. Better institutions are needed to move knowledge to where it is needed, especially in developing countries. The greater challenge to education and science ministries, international organizations (including aid agencies), and the international scientific community is to help build local capacities in science and technology to produce useable knowledge, and to connect local universities and research institutions with national innovation systems for economic development.

The Priority Area Assessment makes recommendations in six broad areas. The recommendations are put forward for consideration by ICSU itself, its International Scientific Unions, National Members, Interdisciplinary Bodies, and Joint Initiatives. Capacity building is a challenge that should affect the entire ICSU family. By working jointly in implementing the recommendations, the ICSU family should be able to increase scientific capacity building through its research programmes, conferences/symposia and dedicated efforts world wide .

AN APPARENT CRISIS IN SCIENCE, CAPACITY BUILDING, AND ICSU'S MISSION AND ROLE

Progress in science and technology offers dramatic opportunities for providing a safer, more prosperous and more sustainable world for people everywhere. Yet, there is a crisis in science, stemming from a range of factors: from the unequal distribution of the benefits of science to the mismatch between the supply of scientists and the demand for scientific advance. The lack of an open dialogue with the public adds to the crisis. Capacity building in science is a critical part of the solution to the crisis in science. ICSU has played a role in many aspects of capacity building in science: from

training of scientists, to contributing to science education reform, to helping reduce the isolation of scientists, to assisting with infrastructure improvements, to building global research programmes and networks [in what follows, the formal recommendations of this Priority Area Assessment are numbered, and the numbers correspond to the numbering of the recommendations as they are introduced in the body of this document].

1. ICSU should undertake a leadership role in mobilizing the world scientific community, represented by its Members, toward the tasks of increasing capacity in science and technology throughout the world.
2. ICSU should work through its Scientific Unions and National Members to widely disseminate the InterAcademy Council report, "Inventing a Better Future. A Strategy for Building Worldwide Capacities in Science and Technology", and should stimulate discussions and actions tending to implement the recommendations of this report.
3. Scientific research programmes of the ICSU family should include capacity-building elements wherever possible.

MAKING SCIENTIFIC CAPACITY BUILDING A PRIORITY

Clear national strategies for capacity building are necessary to link science and technology with goals for economic growth and human well-being, to improve science-based decision-making and problem-solving, and to build future workforces capable of capturing the advances of science and technology. Meeting the challenges of the 21st century and responding to the UN Millennium Development Goals will require international approaches to capacity building that reinforce national strategies, engage society (decision-makers as well as the public and private sectors), and build strong regional and international scientific communities working together toward common goals. Ensuring that efforts are on track will require improvements in census-taking, measurement, and assessment.

4. ICSU, and its Members, should collaborate with major partners [e.g., UNESCO, the Organization for Economic Cooperation and Development (OECD), the Academy of Sciences for the Developing World (TWAS), the InterAcademy Panel (IAP), and the InterAcademy Council (IAC)] to address the importance of national policies and strategies for science and science education.
5. The ICSU family should employ standardized protocols and indicators (e.g., those developed by UNESCO and/or the Organization for Economic Cooperation and Development) to assess the impact of their own capacity building programmes and encourage OECD and UNESCO to document – and if possible, measure – the scientific capacities of countries in terms of the supplies and demands of scientific human capital, their scientific infrastructures, their physical and financial capital (e.g., their levels of investment in and the maintenance of scientific enterprises, including, inter alia, universities and other bodies), and their capacity to integrate scientific knowledge into the broader development of social capital.

BUILDING AND STRENGTHENING HUMAN CAPITAL

Meeting societal goals for sustainable development will require substantial growth and maturation of human resources, including training the next generation of scientists, building scientifically literate publics, improving science education at all levels (especially through inquiry-based methods), assessing the effectiveness of various interventions, solving problems of mobility and brain drain, and encouraging the participation of women in science.

6. The ICSU family, in collaboration with the Academy of Sciences for the Developing World (TWAS), UNESCO and other relevant partners, should pay special attention to the problems resulting from the mobility of human capital between least-developed countries and developing countries, to the "brain drain" and to the knowledge divide between countries, and to related problems.
7. ICSU and its National Members should propose to governments and international agencies (e.g., UNESCO) that policies and support systems be established that will stimulate multidisciplinary research on the evaluation, scaling-up, and design of new educational materials for the benefit of inquiry-based science-education projects.
8. ICSU Unions and National Members, as well as Interdisciplinary Bodies, should use their expertise to help develop teaching material (print and electronic) in order to support education in developing countries that are lagging behind. Unions could also provide quality guarantees for educational material within their areas of competence. National Members and the InterAcademy Panel should contribute to the effort by providing methodologies, best practices, etc.

COMMUNICATING BETWEEN SCIENCE AND SOCIETY

The rapid advance of science and technology requires a renewed and strengthened relationship between science and society. Improvements in public appreciation of science through formal and informal methods, as well as efforts to engage the public and the media with science, are needed to help ensure that public policy is informed by science.

9. ICSU should identify and promote initiatives among its membership aimed at encouraging the public appreciation of scientific issues and the importance of science to society, thereby helping to build a scientifically literate global society. In this context, ICSU should develop a strategy for improving its public outreach – including a more interactive Web-based efforts and public fora, such as science days or fairs associated with major scientific meetings of its Unions or Interdisciplinary Bodies.

STRENGTHENING THE LINKS AMONG EDUCATION, RESEARCH, AND SOCIETY

Strengthening the links among education, research, and society is essential for building future scientifically trained workforces, developing effective national systems of innovation, and connecting the benefits of science with the goals of society. A variety of institutions are designed to reinforce the national, regional, and global connections among education, research, and society. These institutions need continuing support to be effective. Universities play an important role in educating future workforces and in nurturing the basic sciences. Increasingly, they are challenged to strike a balance between academic excellence and research competitiveness, and playing a greater role in national innovation systems. The scientific community needs to help improve incentive structures that recruit talented students to universities and into careers in science, as well as working toward increasing access for scientists and universities to educational materials and scientific publications.

10. ICSU should encourage Scientific Unions, National Members, and Interdisciplinary Bodies to consider constraints in career-development in their fields of expertise. The ICSU family should involve itself in formulating policies in consultation with governments, private-sector employers, and science-funding agencies, and to urge them to address these problems, creating conditions for attracting young talent, especially women, to careers in science.

REVIEW OF CURRENT ICSU ACTIVITIES

Committee on Capacity Building in Science

11. The former members of the Committee on Capacity Building in Science (CCBS) should be thanked for their notable contributions, especially for promoting hands-on, evidence-based learning in science.

12. ICSU should establish a Committee on Science Education (CSE), focusing on the promotion of primary, secondary, and tertiary education. The committee should have access to or be able to generate sufficient resources and staff to carry out its functions. The activities should build upon the pioneering achievements of the Committee on Capacity Building in Science in primary education. Special attention should be given the science education at the secondary level, where Unions could make substantial contributions.

13. The tertiary-level science-education initiative of the Committee on Science Education should interact with the UNESCO Forum on Higher Education, Research, and Knowledge. As far as possible, the committee should work through ICSU National Members, ICSU Regional Offices, the Academy of Sciences for the Developing World (TWAS), and UNESCO, and should also consider promoting relevant research into the education process, itself. In this context, it is essential to involve specialists in the areas of science of learning and science of educational practices.

14. The committee should carefully consider ICSU's comparative advantages in science education. It should develop a work plan with targets for the 2006-2011 period, taking into account other major international initiatives in capacity building.

ICSU/InterAcademy Panel Web Portal on Teaching Science

15. ICSU and the InterAcademy Panel should maintain the portal on the ICSU Web site. It is necessary that the ICSU National and Union Members, as well as the Interdisciplinary Bodies, ensure that the information is regularly updated. Links from the portal should be provided to capacity-building Web pages of the ICSU family. All InterAcademy Panel

members should also ensure that their information is up-to-date.

Global Change SysTem for Analysis, Research, and Training (START)

16. START should be congratulated on its approach to capacity building and should be encouraged to continue its efforts. ICSU Scientific Unions and Interdisciplinary Bodies should consider the approach used by START in linking scientific research to capacity building as one model for developing their own activities.

International Network for the Availability of Scientific Publications (INASP)

17. The International Network for the Availability of Scientific Publications should be congratulated on its past achievements, and should be encouraged to expand its efforts to upgrade the accessibility of good-quality journals from developing countries to other regions of the world. It should continue its efforts to make scientific publications available at an affordable cost worldwide.

18. The International Network for the Availability of Scientific Publications should continue its efforts to train university librarians, and its efforts in the general strengthening of library facilities in developing countries.

19 ICSU, through its National and Union Members, its Regional Offices, and Interdisciplinary Bodies (e.g., the International Network for the Availability of Scientific Publications, INASP) should investigate opportunities for establishing and distributing regional scientific publications.

Policy Committee on Developing Countries (PCDC)

20. The Policy Committee on Developing Countries should coordinate closely with the Committee on Science Education in pursuing its functions.

21. The Policy Committee on Developing Countries should advise the Executive Board on major issues of capacity building in science not covered by the Committee on Science Education.

ICSU Regional Offices

22. ICSU Regional Offices have a critical role to play in capacity building activities in the regional context. The ICSU family should help support this important new initiative in order for the offices to be successful.

23. Regional Offices should be encouraged to promote the linkages of regional centers of excellence in teaching, research, and information (libraries), in conjunction with the Academy of Sciences for the Developing World (TWAS), UNESCO, and the Third World Network of Scientific Organizations (TWNSO).

24. An important function of the Regional Offices could be the establishment of a Web-based information service in relation to fellowships and research grants.

25. Regional Offices should support South-South-North regional research and educational networks, since they provide platforms for collaborative efforts.

ICSU/TWAS/UNESCO/United Nations University – Institute of Advanced Studies Visiting Scientist Programme

26. The ICSU-Academy of Sciences for the Developing World (TWAS)-UNESCO-United Nations University programme should seek additional resources to meet the needs of – and fellowships should preferably be given to – visits linked to research and education programmes with a regional focus.

ICSU/UNESCO Grants Programme

27. In the grants programme, high priority should be given to capacity-building aspects in the broadest context. Attempts should be made to increase the funding base for this successful, competitive programme.

Scientific Unions

28. ICSU Unions should continue their efforts in capacity-building, based on extensive past and current efforts.
29. Unions should develop – individually, or in collaboration with other Unions – region-specific capacity-building programmes involving National Members and Regional Offices, including assisting with the establishment of new national scientific societies.
30. Unions should ensure that the ICSU/InterAcademy Panel Web portal on capacity-building is updated. Capacity-building activities by the Unions should take note of the different strategies developed by the Global Change SysTem for Analysis, Research, and Training (START).
31. The scientific expertise in the Unions should be made available for capacity-building efforts in different countries.

National Members

32. National Members should actively support the capacity-building activities of the Regional Offices.
33. National Members should be encouraged to collaborate within their regions on capacity-building needs and strategies.
34. National Members should reward scientific achievements, facilitate the public appreciation of current scientific issues, and promote the equitable involvement of women, young scientists, and minority communities in science.

Agenda 21 and the Ubuntu Declaration

35. The ICSU Committee on Science Education should take steps, in particular, to address the issue of science education for sustainable development, taking into account ICSU's commitments in this regard, e.g., the Ubuntu declaration.
36. ICSU should strengthen its involvement with the UNESCO Forum on Higher Education, Research and Knowledge, with particular emphasis on the study of research systems. The Regional Offices should be encouraged to collaborate with the Regional Committees of the Forum.

1 Introduction

1.1 THE PROBLEM: AN APPARENT CRISIS IN SCIENCE

It is paradoxical that there should be an apparent crisis in science at the beginning of the 21st Century, a time of unequalled scientific progress, when the impact of new knowledge on the cultural and socioeconomic development of human society is evident. This crisis arises mainly from the lack of appreciation of science by society, and the lack of an open dialogue between the scientific community and society at large. It also arises from the fact that many of the potential benefits of science are not reaching the people and places that most need them. The marvelous advances of science are contrasted with a world full of misery, hunger, ignorance, and violence. Furthermore, some advances have created part of this violence as a result of highly unethical utilization of science.

Science and technology is a necessary, but not sufficient, condition for economic development and must be integrated into what is generally coming to be understood as 'national innovation systems' or a 'national innovation strategy'. This is highlighted in the UN Millennium Project Task Force on Science, Technology and Innovation "Innovation: Applying Knowledge for Development" (www.unmillenniumproject.org]. The UN Millennium Project was commissioned by the UN Secretary-General to develop a practical plan of action to meet the Millennium Development Goals.

Science is also necessary for decision making, since decisions should be based on best available knowledge, much of which is created through scientific research. ICSU was formally responsible for the input of the scientific community to the World Summit on Sustainable Development in 2002. In its series "Science for Sustainable Development" (www.icsu.org], many examples are given on how science can contribute to sustainable development. One of the key recommendations was that science should become more policy relevant and the scientific community made a pledge to help ensure that this would happen. Strong national and international science should be used to ensure that economic development is accomplished in an environmentally and socially sustainable world.

The crisis of science in many countries is generated by the fact that many young people are not attracted by challenges of scientific pursuit, and the values of science are not recognized or appreciated. This crisis also results from the failure of the scientific community to communicate the objectives that it pursues and the implications of scientific discovery to the public, and from the failure of the scientific community to listen to the needs and concerns of the society that nurtures and sustains its activities. In developing countries, salaries and job security in scientific positions are often lower than in other jobs open to intelligent and productive individuals.

There is a mismatch between the supply of scientists and the demand for science. To add to this, there is the emergence of new sub-disciplines and research paradigms, each of which requires investment in different forms of capital. Moreover, in some countries there is a failure to take a long-term perspective and to build a sustained and sustainable infrastructure and workforce that can cover the core areas of scientific research. Instead, there is a tendency to see science as a tool by which short-term economic benefits and profits, producing very high returns on investment, can be generated. Coupled with this is a failure to invest in education and training, and in the stocks of human, financial, and physical capital essential for soundly based science.

Another key factor that causes this paradoxical crisis is that the global nature of science – the basic concept that the quest for knowledge recognizes no national boundaries – is negated by a widening gap between the rich and the poor countries in their capacities to do science, and in their ability to make their science relevant to the needs of their societies. There are very serious constraints on young, curious minds in the poorer nations undertaking scientific careers, and carrying out research that can find solutions to the grave problems that affect the quality of life in those countries. The least developed countries (as defined by the United Nations Development Programme) are extreme cases, where there are very limited opportunities for the young to undertake scientific careers.

Capacity building in science is an opportunity that will reap rewards. Science is exciting and scientific research is rewarding both for the individual and for society. People cannot be pushed into science, but they can be pulled by demonstrating the excitement of science and discovery. ICSU and its Members provide leadership in developing international platforms for collaboration on challenging new topics. Through these efforts they can do much to generate a greater interest in science by society and make science an exciting personal career..

1.2 A CRITICAL PART OF THE SOLUTION: CAPACITY BUILDING IN SCIENCE

The capacity to provide the science and technology necessary to meet the UN Millennium Development Goals – indeed, necessary to meet the basic needs of society – is a critical part of the solution to the crisis in science. This difficult task requires a global building of capacity in science and technology, and the active participation of the international scientific community in partnership with all sectors of human society. In its report to the World Summit on Sustainable Development, the scientific community, through ICSU, argued that science should become more policy relevant and that, in this context, the agenda should be developed in consultation with other major stakeholders in society using a participatory approach (ICSU 2002. Science and

Technology at the World Summit on Sustainable Development. ICSU Series on Science for Sustainable Development No. 11].

National scientific research capacity reflects the extent to which governments prioritize science as an integral part of national development. It includes issues such as setting priorities for national research, ensuring access to international scientific knowledge and stimulating the scientific profession in both the public and private sectors. It also includes investing in scientific institutions and promoting higher education linked to research. Capacity building in science includes consideration of support to individuals as well as institutions in the context of national education and science policy.

Scientific and technological capacity of individuals is increasingly called for as a basis for prudent decision-making for our sustainable future in both the public and the private sectors. The abilities to create, synthesize, and apply scientific and technological knowledge are crucial for the peaceful development of the global society in the 21st century. However, the securing of high-quality human resources with strong scientific and technological talent is one of the major challenges to all societies of the world. Attracting young talent to science, improving the quality of science education, and enhancing public appreciation of science are emerging priority issues (among others) of the governments of both developing and developed countries. In particular, there is a pressing need for scientific capacity building in developing countries, where poor education in general is an inexorable problem. However, the decreased attraction to youth of careers in science and engineering in industrialized countries is also cause for concern.

Capacity building in science means not only the training of people, but also has institutional and other implications. It concerns not only scientists or scientists-to-be, but also other groups of individuals in society. Capacity building in science must include continuous efforts that lead to the establishment of a corps of qualified scientists, with supporting infrastructure, including facilities and working conditions that enable them to conduct research, education, training, and advisory work, particularly in areas of direct societal significance. Because ICSU is a scientific organization, this Priority Area Assessment will refer primarily to capacity building in science. It should be understood that engineering and technology have become closely allied with most areas of science, and are equally necessary. In almost all cases, the steps that must be taken and the recommendations made in this Priority Area Assessment for building capacity in science apply – and should be interpreted to apply – equally to engineering and technology, to the extent that they fall within ICSU's purview.

1.3 ICSU'S MISSION AND ROLE IN SCIENTIFIC CAPACITY BUILDING

The ICSU Mission Statement is formulated as follows:

In order to strengthen international science for the benefit of society, ICSU mobilizes the knowledge and resources of the international science community to:

- Identify and address major issues of importance to science and society.
- Facilitate interaction among scientists across all disciplines and from all countries.
- Promote the participation of all scientists – regardless of race, citizenship, language, political stance, or gender – in the international scientific endeavor.
- Provide independent, authoritative advice to stimulate constructive dialogue among the scientific community and governments, civil society, and the private sector.

This mission clearly encompasses the overall task of capacity building in science. For this reason, ICSU and its members, representing the world scientific community, have expressed their concern about mobilizing the powerful tools of knowledge generated by scientific research to work for the benefit of society. The scientific community must more fully involve governments, civil society as well as business and industry in identifying major issues, where science can assist in developing sustainable societies.

Over the years, ICSU has focused attention on various aspects of capacity building: most intensively, on science education. Many of the Scientific Unions have long maintained teaching commissions to address science education in their particular discipline. In 1961, ICSU established the Committee on the Teaching of Science to look after interdisciplinary science-teaching interests. In response to discussions of an advisory committee on how to follow up on the recommendations of the 1992 Earth Summit in Rio, which stressed the importance of capacity building in science and technology, ICSU set up the Committee on Capacity Building in Science (CCBS). This committee proposed a Programme in Capacity Building, which included core activities concerned with primary-school science education, public appreciation of science, and the isolation of scientists. After considering a range of needs for capacity building in science, the Committee on Capacity Building in Science built a strong case for focusing attention on primary education around the world; an area where all members felt they had much to share, and where early intervention would have long-term payoffs in building a scientifically literate public, and in capturing the imagination of children for pursuing science. The Committee on Capacity Building in Science launched a movement in primary science education that was picked up by national leaders in education and science, as well as by international organizations. Building on the achievements of CCBS, the InterAcademy Panel (IAP) encouraged efforts of national academies and the development of events and conferences concerned with

educating girls, hands-on science teaching, teacher training, technology use, etc..

In the World Conference on Science – organized jointly by the United Nations Educational, Social, and Cultural Organization (UNESCO) and ICSU in 1999 – there emerged a strong call for establishing a close partnership between science and society in addressing the major problems of the new millennium, in order to achieve sustainable development. Specifically, in the 2002 World Summit for Sustainable Development (WWSD), ICSU, together with other partners, highlighted the importance of science education for capacity building for sustainable development.

During the Science Forum of the World Summit for Sustainable Development, the Third World Academy of Sciences and ICSU organized a session on "Capacity Building for Science and Technology," in collaboration with the International Foundation for Science, and Leadership for Environment and Development International (LEAD). In preparation for the World Summit for Sustainable Development, ICSU also published a report on capacity building (Science Education and Capacity Building for Sustainable Development, ICSU Series on Science for Sustainable Development No. 5, 2002]. During the summit, ICSU – together with, for example, the United Nations University, Section 6.12 which calls for the signatory partners to increase their efforts in capacity building. On behalf of the Ubuntu partners, ICSU has also pledged an increased focus on educators in the context of the UN Commission for Sustainable Development. It is hoped that these initiatives will be further developed during the UN Decade of Education for Sustainable Development (2005-2014).

In 2001, the ICSU Scientific Union Members met to discuss issues of common interest. The meeting specifically addressed the need for capacity building. As a result, a compendium of capacity-building activities was compiled that demonstrated the considerable involvement of the Scientific Unions and Interdisciplinary Bodies in capacity-building efforts. In preparation for the Priority Area Assessment on Capacity Building, all ICSU National Members, Scientific Unions, and Interdisciplinary Bodies were invited to update the information in the unpublished compilation from 2001. The material has been made available on the joint ICSU-InterAcademy Panel (IAP) science-teaching Web portal: http://www.icsu.org/1_icsuinscience/CAPA_TeachSci_1.html.

ICSU has established a competitive grants programme to stimulate the development of new ideas and concepts. The programme has been developed in collaboration with UNESCO, and one of the five priority areas is capacity building. Over the past few years, the number of proposals that cover capacity building has steadily increased.

In 2004, one important ICSU partner, the InterAcademy Council, issued the report, "Inventing a Better Future. A Strategy for Building Worldwide Capacities in Science and Technology". This comprehensive report contained an analysis of the many factors involved in strengthening the capacity to engage in science and technology research that are relevant to sustainable development. The report made it clear that the issue of capacity building concerns all countries, rich and poor, and that it requires the joint efforts of many actors in national and international organizations.

As expressed in this report, great importance should be given to attracting, training, and retaining highly qualified human resources. However, the report makes it clear that capacity building also requires other components, such as national strategies with unambiguous priorities and commitments to the development of science and technology; strong national scientific institutions, especially research universities and science academies, with high standards and international connections; a business sector with long-term vision for the requirement to invest in research and innovation, and a willingness to work together with the research community to apply the knowledge acquired; and a scientifically literate society that appreciates the values and contributions of science to its well-being.

The InterAcademy Council report contained numerous wise recommendations addressed to the different partners that must participate in its call to action. In view of the existence of this recent report – with which the Panel is in general agreement – the Priority Area Assessment for Capacity Building has chosen to concentrate its attention on issues and recommendations that are especially pertinent to the ICSU family.

Within this backdrop of ICSU's mission, the Panel makes the following recommendations:

1. *ICSU should undertake a leadership role in mobilizing the world scientific community, represented by its Members, toward the tasks of increasing capacity in science and technology throughout the world.*
2. *ICSU should work through its Scientific Unions and National Members to widely disseminate the InterAcademy Council report, "Inventing a Better Future. A Strategy for Building Worldwide Capacities in Science and Technology", and should stimulate discussions and actions tending to implement the recommendations of this report.*
3. *Scientific research programmes of the ICSU family should include capacity-building elements wherever possible.*

1.4 THE ORGANIZATION OF THIS PRIORITY AREA ASSESSMENT REPORT

Scientific capacity building involves many elements (e.g., education, institutions, facilities, funding, policy, human capital). This Priority Area Assessment aims to build the case for ICSU's focus on improvements in science education for building capacity. Section 2 discusses the national and international policies and strategies that are necessary to strengthen scientific capacity building around the world and to make it a

priority in each country. Section 3 discusses the need to build and strengthen human capital. This includes the relationship of human capital to scientific capacity building, the various dimensions of human capital, and how such aspects as stocks, flows, gender, mobility, and working environment affect the supply and demand. It also highlights the importance of improving science education at the primary, secondary and tertiary levels, and science education based on an inquiry-based methodology.

Section 4 highlights the critical need for improving communication between science and society. It focuses on the need for scientifically literate publics and notes the importance of public engagement with science, as well as improving public appreciation of science. Section 5 examines the strong links among education, research, and society. In particular, this section looks at how to support and nurture institutions, the role of universities in training future workforces, and measures to improve collaboration among international and regional research and educational networks. Section 6 provides a review of current ICSU activities in scientific capacity building, along with recommendations for the future of these activities.

The Terms of Reference for this Priority Area Assessment are included in Appendix 1, along with a list of the members of the Panel that produced this report (Appendix 2).

2 Making Scientific Capacity Building a Priority

2.1 STRATEGIES AND POLICIES FOR SCIENCE AND SCIENCE EDUCATION

It is essential for all countries to develop clear national strategies for building their capacity to do research in science and technology. The national scientific community in each country has to accept responsibility for communicating to society the importance of generating national strategies that will underpin the development of science and technology that is relevant to the needs of its country. The members of the scientific community – working through their scientific societies, academies, universities, and institutes – must make an effort to present advice and recommendations about policies originating from national strategies that will guide education, research, and innovation to their respective political leaders and governments. These should be the policies that are needed to strengthen the research capacity of their countries, and to stimulate the application of knowledge in the solution of specific societal problems. For these efforts to bear fruit, society at large should be aware that science and technology are key elements in the equation resulting in a better quality of life and in sustainable development. The scientific community should also strengthen its collaboration with the private sector, since much of the economic growth of nations builds on science, technology and innovation.

Science should be appreciated because of its value, and because of its contributions to intellectual and socio-economic development. Ignorance of the methods and objectives of science, combined with ignorance of the great impact that the advances of science have on the lives of the common citizen, instigate mistrust and fear of scientific endeavor, and of scientists.

Many of the most serious problems facing humanity in the 21st century are not limited by national boundaries. Poverty and ignorance are present in all countries, and the threats of climate change, depletion of the oceans, the spread of HIV and other pandemics and natural disasters, for example, are challenges to all of humanity. Meeting these challenges and responding to the eight UN Millennium Development Goals require regional and international strategies to develop a global capacity in science and technology.

This leads to the following recommendation:

4. *ICSU, and its Members, should collaborate with major partners [e.g., UNESCO, the Organization for Economic Cooperation and Development (OECD), the Academy of Sciences for the Developing World (TWAS), the InterAcademy Panel (IAP), and the InterAcademy Council (IAC)] to address the importance of national policies and strategies for science and science education.*

2.2 SCIENCE CAPACITY INDICATORS AND ASSESSMENT

The capacity to carry out scientific and technological research requires a large number of factors (human resources, institutions, infrastructure, finances, regulations and safeguards, and social acceptability). The convergence of these factors does not arise spontaneously, but needs to be driven and guided by national policies. In turn, national policies in modern democratic societies are the result of the demands by the different groups that comprise those societies. The existence of national policies that stimulate scientific capacity thus depends on the demands that groups of that society can make for this type of capacity. It is therefore essential that scientists and scientific institutions develop strong arguments demonstrating that the cultural and socioeconomic development of their country or region requires scientific capacity, and requires the policies that are necessary to build that capacity.

One of the arguments is the undeniable fact that all the nations that enjoy high standards of living have policies and actions in place allowing them a high capacity for generating new knowledge through research, and the ability to apply that knowledge to the solution of their problems. The reverse is also true, since the poorest countries have the least scientific capacity. This strong correlation – which demonstrates that the road to development passes through the building of capacity in science – can be established through reliable indicators. Policy that measures this capacity requires these indictors as benchmarks to determine the progress or stagnation that are the results of the actions undertaken. Measuring capacity will require stocktaking or "censuses" of demand and supply of scientific human capital. For practical reasons, these censuses can only be qualitative.

In carrying out censuses of scientific capacity, the variables collected and the categories to be coded (even with qualitative data) should be standardized among countries as much as possible. This permits cross-national comparisons, and thus increases the explanatory power of the analysis. The Organization for Economic Cooperation and Development (OECD) has a great deal of experience in this area. UNESCO also has valuable experience in this field. ICSU should work with the Organization for Economic Cooperation and Development and UNESCO in the identification of appropriate variables, and with the development of categories for coding. This would permit making comparisons of demand and supply of human capital between the developed and the developing countries, would enable the identification of needs and gaps, and would assist decision-making about the most effective interventions.

Note should also be taken of the efforts of the International Foundation for Science to conduct impact assessments through the Monitoring and Evaluation System for Impact Assessments (MESIA; www.ifs.se).

This approach could be used by the ICSU Regional Offices in assessing the impact of activities of the ICSU family in the regions.

For its own sake, ICSU could also consider how such standardized protocols and indicators for capacity building could be expanded to include benchmarks and protocols to assess the impact of discrete capacity building activities sponsored by ICSU and its Members.

This leads to the following recommendation:

5. *The ICSU family should employ standardized protocols and indicators (e.g., those developed by UNESCO and/or the Organization for Economic Cooperation and Development) to assess the impact of their own capacity building programmes and encourage OECD and UNESCO to document – and if possible, measure – the scientific capacities of countries in terms of the supplies and demands of scientific human capital, their scientific infrastructures, their physical and financial capital (e.g., their levels of investment in and the maintenance of scientific enterprises, including, inter alia, universities and other bodies), and their capacity to integrate scientific knowledge into the broader development of social capital.*

3 Building and Strengthening Human Capital

Substantial growth and maturation of human resources – scientifically literate publics as well as science and technology professionals – are required to achieve both the UN Millennium Development Goals for human well-being and the aspirations of individual nations for development. Without indigenous capacity in science and technology, nations cannot construct informed policies or take effective action on issues of national security, economic development, public health, or environmental protection. Providing all citizens with the tools to manage daily life is equally as important as creating the next generation of science and technology professionals to help solve problems. Education and training in science – beginning at the primary and secondary levels – are essentials of capacity building, life-long learning, and creative and analytical thinking. Tertiary education must turn out scientifically literate students of the humanities, as well as provide the solid foundations for those pursuing science and technology careers and continuing advanced study. Linking tertiary education to modern research is necessary for promoting and sustaining national innovation that continues to respond to the needs of society.

3.1 PROBLEMS OF SUPPLY AND DEMAND

Human capital is the key to scientific capacity building. Unlike physical and financial capital, which can be developed or shared with relatively short time delays, human capital cannot be immediately generated to meet emerging needs. Its generation requires education and training, and this is a long process. Scientific talent can be recruited through migration, but this is feasible only if reservoirs of highly skilled workers – scientists, engineers, technologists, and technicians – are available and willing and able to move. For the least-developed countries, determining how to build and retain human capital is a critical concern.

The supply of scientists depends on both stocks (what exists) and flows (movements involving education and training, recruitment, promotion and seniority, retirement, and career mobility; shifts into and out of science, or to another job, or labor-force migration). Capacity-building efforts tend to focus on increasing the number of scientists. The quality of scientists – for example, the degree of training and specialization – is important because it affects the ability of human capital to provide a workforce in disciplines that are undergoing frequent metamorphosis. The supply of scientifically trained workforces in commercial, industrial, and policy arenas, and teachers at all levels, is also important. People who might be engaged in funding and prioritizing research, and in interpreting and transferring knowledge gained from research, must also be scientifically aware to a relatively advanced state.

Understanding demand for scientific human capital and making decisions about what science is needed and how to get it – through intellectually driven efforts, or through societal- or goal-driven efforts – is extremely difficult. Future demand will be dependent not just on existing needs, but on changes in technology, on the speed with which that is taken up, and on demand for any products or evidence-bases generated by science. Future demand will also be dependent on the way in which the sciences are affected by emerging and fashionable issues, which hinges in part on the public appreciation of science. Demand is also affected by what is a thorny factor in any country or discipline: how long a fundamental science infrastructure that appears to have no application to issues currently deemed "relevant" should be maintained. Demand will also vary by the development path followed by any country or region, by the issues that are critical for it, and by the country's or region's capacity to absorb the available scientific workforce.

Following the axiom that "what gets measured gets done," it is important to measure the supply and demand of scientists in order to determine where to focus capacity-building efforts. This is extremely difficult. Part of the difficulty is in selecting what to measure, e.g., who counts as a "researcher." Another problem is the collection of data, e.g., how to deal with privacy, now exacerbated by security concerns. Information is required, at the very least, on the age, gender, workplace, qualifications, seniority, and specific job of each scientist, technologist, and technician in order to make satisfactory analyses of supply. A number of agencies (e.g., the Organization for Economic Cooperation and Development) have developed protocols for collecting these data to assess the stocks of scientists. The US National Science Foundation reports on "Science and Engineering Indicators" (www.nsf.gov) also provides background information on science and technology capacities world wide.

Documenting the flows of scientists is even more difficult than assessing stocks. Flows are difficult to measure, in part because an element of forecasting is required, and in part because both the determinants and paths of flows are very complex and multi-dimensional. Some relevant factors include the time it takes to train a scientist, the mobility of highly skilled scientists, the inability of labour markets to respond rationally and efficiently to the supply of human capital, the effects of gender and mobility (especially, brain drains), and the working environment.

Science, and the attraction and retention of young people in the profession, has suffered because of the insecurity of annual funding rounds, low salaries by comparison with managers in science agencies, an emphasis on competition rather than collaboration, micro-level management intervention, and short reporting periods

(quarterly or annually). There is a lack of understanding of how long it takes to develop new knowledge and the importance of basic research. ICSU issued a statement in 2004, which addresses the importance of basic research (www.icsu.org].

3.2 PROBLEMS OF MOBILITY AND BRAIN DRAIN

Mobility is influenced by working conditions; self-esteem or sense of fulfillment of workers; access to colleagues, facilities, and technologies; diversity of opportunities; socio-economic uncertainties; and other factors. It is a major concern for many nations that have invested in the training of scientists, but are unable to employ them. But brain drain – the more persistent loss of national talent – is primarily an issue facing developing countries (although it is also important for some smaller, developed countries), and thus one fundamental to the imbalances in sustainable development. These losses incurred from the scientific diaspora are devastating, and require significant redress to ensure sufficient retention and development of human capacity in the new and challenging areas of science, especially those related to solving national problems of development.

Some attempts have been made to stem the drain, often on a small scale, or bilaterally between institutions in the more developed countries and the less developed countries. These include the return of qualified nationals; links with scientists who have returned home but are not working in science; graduate programmes that are split between the home country and the host country of the student; and state-sponsored repatriation programmes, such as in South Korea or Taiwan. There are also sometimes more spontaneous effects, particularly for developing countries that are rapidly industrializing. For example, in some countries, working conditions are now such (and the costs of living are so favorable relative to salaries) that graduates are choosing to stay at home rather than migrate.

This leads to the following recommendation:

6. *The ICSU family, in collaboration with the Academy of Sciences for the Developing World (TWAS), UNESCO and other relevant partners, should pay special attention to the problems resulting from the mobility of human capital between least-developed countries and developing countries, to the "brain drain" and to the knowledge divide between countries, and to related problems.*

3.3 PROBLEMS OF GENDER BALANCE

The World Conference on Science, organized by UNESCO and ICSU, in its Declaration on Science and the Use of Scientific Knowledge, called attention to the fact that "...most of the benefits of science are unevenly distributed, as a result of structural asymmetries among countries, regions and social groups, and between the sexes." Further, the declaration noted the historical imbalance in the participation of men and women in all science activities, the barriers that preclude the full participation of women in science, and the need for gender mainstreaming in all aspects of science and technology. This includes promoting the access of girls and women to scientific education at all levels; improving conditions for recruitment, retention, and advancement; raising societal awareness of the contributions of women to science and technology; undertaking research to document the constraints and progress in expanding women's roles; monitoring best practices; and establishing international networks of women scientists. It should also be noted that in some societies, women are excluded from scientific careers.

The International Union of Pure and Applied Physics (IUPAP), together with UNESCO, organized a major conference on 'Women in Physics' in 2003. The InterAcademy Council and UNESCO are currently working on a report on gender issues and the results of these studies, to be made available in early 2006. The outcomes of these efforts sh be considered by ICSU as it undertakes its own efforts to increase its attention to issues relating to women in science.

3.4 EDUCATION, RESEARCH, AND DEVELOPMENT

There are a number of aspects of science education that require research. This research should be encouraged by the scientific community, since the knowledge generated by this research should greatly influence the successful implementation of new educational models. These are problems in massive science education that require the joint efforts of scientists, educators, social scientists, and government authorities at the international level.

Evaluation mechanisms for the assessment of the learning progress of children that have experienced inquiry-based science-education methodology are necessary. There is a great need to develop ways and instruments to help monitor the degrees of success of projects using inquiry-based science-education methods. A joint international effort to generate a reliable evaluation method would be very useful. It is clear that this evaluation is rather complex, because the inquiry-based science-education projects also affect other important parameters, including teacher self-esteem, classroom atmosphere, teamwork within classroom groups, communication skills of students, and critical analytical skills. This problem of evaluation requires research work by multidisciplinary teams.

Scaling-up models are important. Inquiry-based science-education projects are expected to spread gradually to cover as many schools and children as possible. It is important to test and analyze organizational models that

can achieve this scaling-up without affecting the quality control of the teacher training or the materials, and while maintaining the key involvement of the local community and of scientists and engineers.

This leads to the following recommendations:

7. *ICSU and its National Members should propose to governments and international agencies (e.g., UNESCO) that policies and support systems be established that will stimulate multidisciplinary research on the evaluation, scaling-up, and design of new educational materials for the benefit of inquiry-based science-education projects.*
8. *ICSU Unions and National Members, as well as Interdisciplinary Bodies, should use their expertise to help develop teaching material (print and electronic) in order to support education in developing countries that are lagging behind. Unions could also provide quality guarantees for educational material within their areas of competence. National Members and the InterAcademy Panel should contribute to the effort by providing methodologies, best practices, etc.*

4. Communicating Between Science and Society

In order to establish a productive dialogue among the scientific community and society and its leaders, it is necessary for scientists and the major national scientific institutions to undertake to improve the public appreciation of science and public engagement with science. A well-informed public can help ensure scientifically informed public policy. It also will be better positioned to understand the risks and benefits of new technologies, and to make individual decisions about health, well-being, and other aspects of daily life. Sound decision making must be based on best available knowledge and scientific information thus needs to be made available to decision-makers in appropriate ways. An engaged public can help assure that the channels for receiving scientific and technical information are open and unrestricted.

Communicating science to the public involves various formal and informal channels, including scientists themselves, public information officers, science journalists, science centers and museums, schools, libraries, electronic games, and other media tools. ICSU's activities in this area are primarily focused on print media, including press releases, documents, newsletters, and journal articles, but also include Web-based efforts, such as providing links to programmes of the Interdisciplinary Bodies as well as Members and Scientific Associates.

In addition to science education for school children, science and its progress has to be continuously presented to our national and international society. Scientific knowledge and understanding rapidly become obsolete. The rate of discovery and the development of new applications are so rapid that the layman cannot grasp the new issues and impacts directly affecting them. Yet, the development of science and its technological applications depend completely on the support and appreciation of society. This fact makes it very evident that one of the important topics of the dialogue between science and society must be centered on a concerted effort from both sides to make the aims, methods, and consequences of scientific pursuit understandable to all members of society.

Individual scientists and scientific organizations should make a much more vigorous effort to widely communicate the advances, values, and contributions of science to the public. They should also clarify the limitations and uncertainties of science in which there are no absolute or permanent truths. Social and political institutions need to build bridges, where scientists and members of the rest of society can meet and reach understanding.

Institutions that fund scientific research should require that as an integral part of their projects researchers should include activities explaining their objectives and their results to the public. Universities that train journalists should give increased importance to scientific journalism in their curriculum, and should make sure that graduating journalists are scientifically literate.

This leads to the following recommendation:

9. *ICSU should identify and promote initiatives among its membership aimed at encouraging the public appreciation of scientific issues and the importance of science to society, thereby helping to build a scientifically literate global society. In this context, ICSU should develop a strategy for improving its public outreach – including a more interactive Web-based efforts and public fora, such as science days or fairs associated with major scientific meetings of its Unions or Interdisciplinary Bodies.*

5. Strengthening the Links Among Education, Research, and Society

Education is expected to instill the foundations of basic science and scientific and technological knowledge, while at the same time ushering in curiosity, propagating positive attitudes, and encouraging investigative skills and innovation. Research is expected to advance knowledge and produce outcomes of benefit to society. Whether in private or public universities and research centers, research and development rely significantly on the cumulative development of basic sciences, cultivated over a long period, extending from primary to university education. Strengthening the links among education, research, and society is essential for building future scientifically trained workforces, developing effective national systems of innovation, and connecting the benefits of science with the goals of society.

Factors that will contribute to this strengthening include establishing a variety of research and educational institutions; developing new and innovative pedagogical skills and using state-of-the-art educational and methodological approaches and instruments; fostering general interest in science, while encouraging specialization in science to meet future research and development requirements; encouraging mobility of researchers, educators, and students to share experiences and build expertise; ensuring full utilization of the opportunities offered by information and communication technologies in the exchange of educational methods and research findings; and connecting the skills and knowledge produced with the needs of communities.

Science policy is an essential component of any attempt to foster the linkages between education and research. While there is a well-established science policy in scientifically and technologically advanced countries (as noted in Section 2 of this report), there is a need to establish such policies in developing countries, especially to yield significant outcomes from poorly funded university education and research centers. It is also essential to ensure the involvement of the science community in developing such policies. The creation of science-policy frameworks is necessary to articulate education and research gaps to be filled by practical national programmes. This will depend on providing technical assistance to bridge the knowledge gap where it exists, and to foster a culture of science education and research where such a culture is absent.

5.1 SUPPORTING AND NURTURING INSTITUTIONS

A variety of institutions are designed to reinforce the connections between education, research, and society: including universities, autonomous centers of excellence, virtual networks, academies and research councils, professional societies, museums, libraries, and international organizations. Universities educate and train future workforces, and produce research and development connected with societal needs and goals, thereby serving as community knowledge centers. Centers of excellence advance research and training, serve an important role in innovation because they attract a critical mass in terms of excellent personnel and facilities with world class research output, and produce knowledge of local and regional benefit. Virtual networks of excellence connect geographically dispersed research Programmes to share and build knowledge. Independent national or regional academies of science, engineering, and medicine recognize achievement, and use their membership authority to advise decision-makers on scientific and technical aspects of public policies. Professional societies support the disciplines and promote interdisciplinary activity, as well as look after issues affecting the education and professional development of scientists, the conduct of science, and the communication of science to society. Museums and libraries serve as repositories of knowledge and collections that provide critical links between research communities and the broader public. International organizations improve scientific cooperation, connect research communities around the world, and facilitate the conduct of science around geographic and other borders.

In order for scientific institutions to be successful, they need access to infrastructure and technical support, as well as excellent scientists. The unevenness of university capacities in emergent and new technologies requires devoting financial and human resources to address the needs for the conduct of scientific research. This would include, for example, the training of more technicians. Organizations such as the International Foundation for Science (IFS) have established networks of laboratory technicians to share techniques and assist training in emergent and new technologies. One such example is the Network of Users of Scientific Equipment in Southern and Eastern Africa (NUSESA).

ICSU has a good track record for promoting international science and technology cooperation, working through its National Members, Unions, and Interdisciplinary Bodies to strengthen institutions for education and research. Convening scientists around common concerns within the disciplines or around interdisciplinary problems – such as global environmental change – helps focus attention on the issues, builds consensus about the research needed to advance science and move resources toward priority areas, and encourages training and capacity building within the scientific community to work on the problems over the longer term. This consensus is particularly valuable for scientists who come from countries without a

critical mass of researchers or resources devoted to these problems, because it serves as an effective mechanism through which they obtain funding and garner support from their governments and institutions to contribute to the research objectives, attract graduate students, and build exchange Programmes that tie their researchers with others working on similar topics. The networks resulting from these efforts are powerful tools for developing and coordinating major international research efforts, building global scientific capacities, providing a support structure for scientists, and linking scientists with one another and with new technologies, educational methodologies, and resources. The Global Change SysTem for Analysis, Research, and Training, or START, which is described in more detail in Section 6.3, is an example of such a network: linking education (training global-change scientists in developing countries), research (collaborating institutions and scientists working on the problem of global environmental change), and society (providing relevant information to policy makers and governments).

This leads to Recommendation 16 in Section 6, which suggests that other ICSU bodies should emulate the model of START in research and capacity building, and recommendations concerning the capacity building activities of Regional Offices.

5.2 EDUCATING FUTURE WORKFORCES WHILE PROMOTING INNOVATION

Universities, together with their research centers, provide long-term integrative and innovative linkages between education and research. Strong universities are crucial for expanding national science and technology capacities, especially when research is linked with systems for improving innovation through the private sector (e.g., research parks), national laboratories, etc. Now more than ever, universities have a key role to play in furthering peace and democracy, as places for the production and dissemination of impartial and rational scientific discourse that helps bring consistency and understanding to a complex and uncertain world; for critical thought and surveillance of developments in knowledge and societal issues; and for dialogue among disciplines, approaches, and cultures. It is important that universities continue to perform these roles, although the increase in external funding compared to core budgets can be a cause for concern. The challenge of the century may no longer be the progress of technology, but the building of a world, in which the economic, the environmental, the social, and the cultural spheres are reconciled with each other and integrated with each other. The sciences and humanities are essential for this, and universities should play a strong role in facilitating the linkages between them.

In today's rapidly changing world, the purpose of a university education should be to turn out graduates with a sufficiently solid and varied mix of core skills so that they will remain adaptable throughout their working lives. The long-term employability of students should be seen as the goal; preparing them generally for a working life over the long haul, and not restricting them to a particular educational route, qualification, or job opening. For those students aiming to build a scientific career, tertiary training should provide skills that are transferable from one university setting to another.

Traditionally, universities have been entrusted with the tasks of educating, nurturing, and training students, with the realization that there is a need for investment in critical human capital, resources, and infrastructure to ensure that the benefits of education accrue to society. In addition, universities have for centuries played a pivotal role in generating the scientific knowledge used by the private sector to generate economic resources and human well-being. Increasingly, universities are expected to contribute to building the knowledge society, to becoming partners in economic growth, to generating wealth and prosperity, and to improving the quality of life. The transformation of science into technology requires deliberate and systematic efforts to foster the linkage between education and scientific research.. Because the private sector is still not capable of providing the education and training necessary to populate its own research and development centers, it is common practice for firms to locate next to universities. According to the Lambert review of business-university collaboration (www.lambertreview.org.uk], "Companies around the world are increasingly outsourcing their R&D activities so that the role of universities in economic development everywhere is becoming more important." This reinforces the view that the benefits of investing in education and research go beyond the university to accelerate economic and social development. To maintain the independence of universities while contributing to economic development in partnership with business and industry will be a true challenge.

The generation of scientific knowledge and new technologies depends on the continued training, motivation, and recognition of young scientists. It is only through encouraging talented, creative, and innovative young scientists that the world will be assured of meeting the scientific and technological challenges of the future. The Academy of Sciences for the Developing World (TWAS) and the International Foundation for Science (IFS) provide good examples by making available competitive research grants for young scientists. Expanding these types of programmes and encouraging more exchanges of scientists (especially "South-South-North") will help recognize, mobilize, and share talent.

The absence of a proper career structure and adequate financial remuneration dissuades many young graduates from embarking on a scientific research career. Consequently, some of the more capable science graduates are attracted to other careers. The scientific community should take steps to address these shortcomings by working with governments and decision-

makers to improve the incentive structures that recruit talented students into careers in science.

This leads to the following recommendation:

10. *ICSU should encourage Scientific Unions, National Members, and Interdisciplinary Bodies to consider constraints in career-development in their fields of expertise. The ICSU family should involve itself in formulating policies in consultation with governments, private-sector employers, and science-funding agencies, and to urge them to address these problems, creating conditions for attracting young talent, especially women, to careers in science.*

5.3 NARROWING THE KNOWLEDGE GAP WITH EDUCATIONAL MATERIALS AND SCIENTIFIC PUBLICATIONS

Factors affecting the efficiency and effectiveness of universities reinforce scientific and technological knowledge gaps, as well as contribute to socioeconomic and developmental gaps. One factor is the disparity in university resource bases (not only between developing and developed countries, but also among developing countries), and in the ability of universities to procure the educational materials needed for research and education. Another is the fact that many universities are inadequately equipped to access educational materials and recent scientific publications that are important for keeping up with developments in science and technology. Regional capacity assessments of universities' access to educational material and publications, as well as of the capacity of university governance structures to deal with the new context of higher-education development, are equally important in order to quantify institutional capacity-building requirements. In some developing countries, partnerships among international science and technology networks and the regional networks and university associations also require strengthening, in order for them to be able to assist in the procurement of or in providing access to educational material, by creating "educational material hubs."

Many programmes (e.g., the International Network for the Availability of Scientific Publications, INASP, see Section 6.4) have contributed significantly to reducing the isolation (political, financial, geographic, or due to other reasons) of scientists, especially by increasing access for scientists and universities to scientific publications. One way to connect scientists and universities within a geographic area and to promote sharing of the latest findings and techniques is to develop regional journals, e.g., the multidisciplinary journal Interciencia is published monthly by the Interciencia Association, which is dedicated to stimulating research and communication among scientific and technical communities of the Americas. See further Section 6.4.

6. Review of Current ICSU Activities

Efforts to improve the capacity to perform science have been undertaken in various ways by almost all constituents of the ICSU family. The major capacity-building activities of the different ICSU components are briefly described here, together with salient aspects of the Panel's evaluation. A number of specific actions for the members of the ICSU family in supporting capacity-building activities are proposed; many should be closely integrated with the work of its Policy Committee on Developing Countries (see Section 6.5). Action on capacity building needs to be incorporated into the ICSU Strategic Plan 2006-2011, taking into account other major international initiatives in capacity building. Many other international and non-governmental organizations besides ICSU are also involved in attempts at capacity building in science. The global, regional, and national dimensions of such capacity-building efforts are outlined in the InterAcademy Council report. The caveat for the recommendations made here is that the relationships among ICSU and all the other players involved should be clarified at the outset. This arises from the needs to avoid wasteful duplication of effort and resources, to improve awareness of current issues and initiatives, and to achieve better coordination in the international efforts to build capacity in science. Some important organizations for consideration include UNESCO, the World Bank, the Academy of Sciences for the Developing World (TWAS), the InterAcademy Council (IAC), the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP) for environment and sustainable development.

6.1 COMMITTEE ON CAPACITY BUILDING IN SCIENCE (CCBS)

The Committee on Capacity Building in Science was launched at the 24th General Assembly of ICSU in 1993 to build on the activities of the previous ICSU Committee on the Teaching of Science. A Programme for Capacity Building in Science was established at the 25th General Assembly of ICSU in February 1997. The initial goals of this Programme were to improve science education at the primary-school level, particularly in developing countries; to increase the public appreciation of science; and to reduce the isolation of scientists.

In her submission to the Priority Area Assessment, the Chair of the Committee on Capacity Building in Science reported that the committee had focused on science education in primary schools because it held the opinion that it was at this early stage that children's views of the physical and biological world are shaped, ideas were formed about the role of science in their daily lives, and skills were developed to collect and objectively analyze data. Consequently, the teaching of science was recognized as imparting skills that enrich wider society, in addition to providing scientists for the future. The Committee on Capacity Building in Science was of the opinion that science was poorly taught in both developed and developing countries in primary schools. The shortcomings identified by the committee included teachers with no science background, encouraging rote learning in science, lack of teaching materials, poor utilization of locally available teaching materials, and the lack of a sufficiently large science-education community and communication difficulties in many developing countries.

The Committee on Capacity Building in Science noted that while many countries were attempting to improve the quality of science education, the committee had a role to play in improving international cooperation among scientists and educators that would enhance global cooperation and strengthen the programmes of individual countries. From the beginning, based on its own expertise, the committee gave priority to a hands-on, inquiry-based approach to science education, in preference to pedagogical approaches. It felt that this builds on a child's reality, interests, and ways of learning, and facilitates the use of local examples to teach fundamental ideas.

The Committee on Capacity Building in Science addressed these issues through organizing international conferences to exchange best practices of curriculum development, hands-on and inquiry-based school science-education programmes, and other ways to improve the quality of science and mathematics education. These conferences brought together scientists and educators, and were particularly beneficial to the host countries. The first Committee on Capacity Building in Science conference was held in Budapest in June 1999, prior to the World Conference on Science. The conference brought together scientists and science educators. It served to enlighten many of them to ongoing science-education efforts, and highlighted the enormity of the problems in delivering quality science education.

A second conference was organized in Beijing in November 2000. The aim of the conference was to discuss one of the key recommendations of the World Conference on Science viz. "Educational institutions should provide basic science education to students in areas other than science. They should also provide opportunities for lifelong learning in the sciences" (www.unesco.org/science/reports.html). The conference also helped to reinforce a major science-education reform of primary schools in China. Participants from 21 countries attended the conference, and it generated visible efforts in improving science education in Brazil, Indonesia, Malaysia, and Sri Lanka, as well as the formation of an Asia-Pacific regional network of science educators, which met subsequently in Kuala Lumpur in October 2001.

A third Committee on Capacity Building in Science conference, held in Rio de Janeiro in 2002, emphasized

the need for internationally applicable research in the areas of science education. Examples of this included the effects of teacher-training methods and the role of new technologies for evaluation and collation of ongoing science education, improved networking and partnerships among ICSU membership, and a continuing stress on quality science education in primary schools. In this context, the Committee on Capacity Building in Science, in association with the InterAcademy Panel, helped establish a Web portal for science education (described in Section 6.2).

In her presentation to the Panel, the Chair of the Committee on Capacity Building in Science stated that it might be appropriate for the committee to now move to the secondary and tertiary levels of education, making use of the networks already developed. She also said that more staff and resources would be needed to take on a wider role in capacity building, and that the ICSU Regional Offices and UNESCO may be able to help in this context. The Chair also expressed the opinion that the comparative advantage of ICSU in the field of science education was the access it had to both Scientific Unions and National Members.

At the Forum on Capacity Building for Science of the 27th ICSU General Assembly, concerns were expressed concerning the need to regard capacity building in science as being more than addressing science education in schools, the requirement to reach out more directly and systematically to the teaching community, and the necessity for placing increased emphasis on collaboration and networking between developing countries. The 27th General Assembly extended the mandate of the Committee on Capacity Building in Science until the end of 2003, and decided to assess the role of ICSU in capacity building in science.

This supports the following recommendations:

11. *The former members of the Committee on Capacity Building in Science (CCBS) should be thanked for their notable contributions, especially for promoting hands-on, evidence-based learning in science.*
12. *ICSU should establish a Committee on Science Education (CSE), focusing on the promotion of primary, secondary, and tertiary education. The committee should have access to or be able to generate sufficient resources and staff to carry out its functions. The activities should build upon the pioneering achievements of the Committee on Capacity Building in Science in primary education. Special attention should be given the science education at the secondary level, where Unions could make substantial contributions.*
13. *The tertiary-level science-education initiative of the Committee on Science Education should interact with the UNESCO Forum on Higher Education, Research, and Knowledge. As far as possible, the committee should work through ICSU National Members, ICSU Regional Offices, the Academy of Sciences for the Developing World (TWAS), and UNESCO, and should also consider promoting relevant research into the education process, itself. In this context, it is essential to involve specialists in the areas of science of learning and science of educational practices.*
14. *The committee should carefully consider ICSU's comparative advantages in science education. It should develop a work plan with targets for the 2006-2011 period, taking into account other major international initiatives in capacity building.*

6.2 ICSU/INTERACADEMY PANEL WEB PORTAL ON TEACHING SCIENCE

The Teaching Science Web portal (www.icsu.org/1_icsuinscience/CAPA_TeachSci_1.html) is a joint project between ICSU and the InterAcademy Panel for International Affairs, in collaboration with the French project "La Main à la Pâte." It developed out of an initiative of the Committee on Capacity Building in Science (Section 6.1) to provide a single comprehensive source of information on primary-school science education across the world. It includes information on educational systems and "hands-on" science-education programmes from many countries that are relevant to all those interested in the policy aspects and implementation of science education.

The portal presently contains information on the science-education and training activities that are being carried out by the ICSU membership: Scientific Unions, National Members, and Interdisciplinary Bodies/Joint Initiatives. This information extends beyond the primary-school level, and includes a broad range of secondary, tertiary, and post-graduate level initiatives. The data are an update of a compilation of capacity-building initiatives that ICSU prepared based on the meeting of Scientific Unions in 2001. In effect, the portal is a "clearing house" for information on what these organizations – representing scientists across the globe – are doing to help develop the next generation of scientists. The purpose of the Teaching Science Web site is to link education decision makers and scientists to projects and resources to support quality science education, to collect and share information on ICSU and InterAcademy Panel educational and training activities, and to provide examples of "best practices" in science education and training. The Teaching Science Web site is therefore a tool for supporting efforts to improve science education around the world.

The usefulness of the portal would be enhanced by linking it to the Web sites dealing with capacity-building science-education activities of the individual Unions, National Members, Interdisciplinary Bodies, and Joint Initiatives. The value, use, and sustainability of the portal can also be improved by giving it greater prominence among the wider science-education community, UNESCO, etc. A stable source of funding for maintaining

the portal, provision of the necessary supporting staff, and a permanent and appropriate location could enhance its usefulness.

This leads to the following recommendation:

15. *ICSU and the InterAcademy Panel should maintain the portal on the ICSU Web site. It is necessary that the ICSU National and Union Members, as well as the Interdisciplinary Bodies, ensure that the information is regularly updated. Links from the portal should be provided to capacity-building Web pages of the ICSU family. All InterAcademy Panel members should also ensure that their information is up-to-date.*

6.3 GLOBAL CHANGE SYSTEM FOR ANALYSIS, RESEARCH, AND TRAINING (START)

START is sponsored by three ICSU Interdisciplinary Bodies and Joint Initiatives: the International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP), and the International Human Dimensions Programme on Global Environmental Change (IHDP). It fosters a regional approach to interdisciplinary global-change research . START's mission is to

1. Develop a system of regional networks of collaborating scientists and institutions to conduct research on regional aspects of global change, to assess the causes and impacts of regional global change, and to provide relevant information to policy makers and governments to assist in formulating adaptation strategies.
2. Enhance scientific capacity in developing countries by strengthening and connecting existing institutions, and training global-change scientists and providing them with improved and enhanced access to data, communication technology, and research skills.
3. Mobilize the resources required to augment existing global-change scientific capabilities, infrastructure, and activities in developing countries.

START has made significant progress in its mission. It has initiated a number of activities of particular relevance to developing countries, and has been very successful in raising programme-based funds for its activities.

Collaborative research activity – for example, through specific programmes addressing regional climate variability and change, land-use change, and its impact on terrestrial ecosystems, and assessment of impacts and adaptations to climate change, etc. – has contributed significantly to building scientific capacity and to providing valuable new knowledge in the field of environment. This has also entailed organizing more than 70 planning and research workshops.

START has organized three focused global-change advanced institutes: Climatic Variability and Food Security; Urbanizations, Emissions and the Global Carbon Cycle; and Vulnerability to Global Environmental Change. Each institute comprised three elements: 1) An intensive seminar held at an international center of excellence; 2) follow-on research projects that enabled the participants to conduct research using the knowledge and tools gained at the seminar; and 3) a summary workshop to exchange results and experiences. These institutes have been successful in training young scientists from developing countries in tackling problems associated with global environmental change and sustainable development.

Other mechanisms utilized by START in pursuit of its mission are: (i) short-term fellowships for scientists; (ii) studentships for PhD/MPhil studies; (iii) small research grant awards; (iv) prizes for achievements by young scientists; and (v) visiting scientist/lecturer awards.

The START Secretariat has been funded through US agencies and, more recently, through overhead on programme grants. However, as stated by the Executive Director of START in his presentation to the Panel, both the Secretariat and START programmes require more stable funding sources to continue their functions and to implement the newly formulated Decadal Plan for Capacity Building in Global Change Science. The Panel concurred with the envisaged needs, in view of the successful achievements of START to date.

With regard to capacity building, START's underlying principles, outlined in its 1996 implementation plan, are still taken by it as being valid: capacity building is more than training; confidence-building is an essential component of capacity building; a multiplier effect is best achieved by concentrating on early-mid-career scientists; and capacity building should be research driven, and not based on one-off, episodic events. There is a need to consider how START's successful capacity-building efforts in global-change science can be coordinated with ICSU's overall capacity-building effort.

This leads to the following recommendation:

16. *START should be congratulated on its approach to capacity building and should be encouraged to continue its efforts. ICSU Scientific Unions and Interdisciplinary Bodies should consider the approach used by START in linking scientific research to capacity building as one model for developing their own activities.*

6.4 INTERNATIONAL NETWORK FOR THE AVAILABILITY OF SCIENTIFIC PUBLICATIONS (INASP)

The International Network for the Availability of Scientific Publications was established in 1992 by ICSU. Its mission is to enhance the flow of information within and between countries, especially those with less-developed systems of publication and dissemination. The International Network for the Availability of Scientific Publications seeks to fulfill its mission through a number of activities, in particular:

6.4.1 Provision of Advisory and Liaison Services

- Offer advice and support on all aspects of literature publication and dissemination, especially in response to and in partnership with institutions in developing and transitional countries;
- Assist a number of funding and development agencies in the establishment and implementation of information-related programmes.

6.4.2 International Network for the Availability of Scientific Publications -Health (INASP-Health)

This programme aspires to strengthen the overall effectiveness of international health-information activities through cooperation, analysis, and advocacy. It acts as a facilitator and focal point for organizations, North and South, working together to improve access to reliable, relevant information for health professionals in developing and transitional countries.

6.4.3 Programme for the Enhancement of Research Information (PERI)

In facilitating the acquisition of full-text online journals, current-awareness databases, and document delivery, the International Network for the Availability of Scientific Publications has been working with individual publishers, "packagers" of information, and consolidating subscription agents. The goal is for resources available through the Programme for the Enhancement of Research Information to be affordable, so that their acquisition is sustainable in the long term. The International Network for the Availability of Scientific Publications has been successful in negotiating differentially priced countrywide access licenses at discounts of 90% to 98%.

The Programme for the Enhancement of Research Information provides access to over 8000 full-text online journals, and to many of the world's leading bibliographic and reference databases, including those from Blackwell's, CABI, EBSCO, Emerald, Gale, Institute of Physics Publishing, Oxford University Press, OVID (Silver Platter), Springer, the Royal Society, and Update Software. Through the Programme for the Enhancement of Research Information, the International Network for the Availability of Scientific Publications also assists in establishing institutional, national, and regional online services to enable the results of research undertaken and published locally to become more widely known and accessible. One successful model that has been developed is African Journals Online (AJOL) , and similar initiatives in other regions are under development to increase worldwide knowledge of indigenous scholarship.

The pilot phase of the Programme for the Enhancement of Research Information confirmed requests from librarians and researchers for quality, relevant training in order to use the Internet, to utilize information available to them to its full potential, and to help them identify and evaluate other information sources. Extensive experience with partner institutions has led to the adoption of a locally facilitated "traveling" workshop methodology.

The Programme for the Enhancement of Research Information facilitates in-country or regional workshops to assist researchers and publishers in improving their publishing operations. The training aims to provide exposure to the options available from developing information and communication technologies. For example, following discussions with journal publishers in Africa, the International Network for the Availability of Scientific Publications developed a pilot project to assist African titles in publishing full text on the Web. Initially, ten journals are being supported in the African Journals Online Publishing Project (AJOPP) . An inception workshop covered all issues in electronic-journal publishing, and provided the necessary knowledge to allow journal publishers to decide on their best option for moving forward into electronic full-text publication. Each journal produced strategic and action plans of how it intended to mount full text on the Web, and is being assisted in following through with its preferred method of going online.

The International Network for the Availability of Scientific Publications has significantly improved the availability of scientific literature to resource-poor nations, and has helped disseminate scientific information generated in Africa. There is a need to build on these achievements. For example, valuable scientific data from journals in Asia, Latin America, the Arab Region, and the countries of the former Soviet Union, still receive poor coverage in the popular abstracting services. There is a concomitant need to improve the quality of these journals and their accessibility in the more scientifically advanced nations. One obvious advantage of this, as evident from some recent developments, is that better evaluation of patent applications concerning developing-country bio-resources can be performed by patent offices. Another is that regionally relevant findings in the area of the environment will be more readily accessible, internationally.

This leads to the following recommendations:

17. *The International Network for the Availability of Scientific Publications should be congratulated on its past achievements, and should be encouraged to*

expand its efforts to upgrade the accessibility of good-quality journals from developing countries to other regions of the world. It should continue its efforts to make scientific publications available at an affordable cost worldwide.

18. *The International Network for the Availability of Scientific Publications should continue its efforts to train university librarians, and its efforts in the general strengthening of library facilities in developing countries.*

19 *ICSU, through its National and Union Members, its Regional Offices, and Interdisciplinary Bodies (e.g., the International Network for the Availability of Scientific Publications, INASP) should investigate opportunities for establishing and distributing regional scientific publications.*

6.5 POLICY COMMITTEE ON DEVELOPING COUNTRIES (PCDC)

A Committee on Science and Technology in Developing Countries (COSTED) was established by ICSU in 1966. The Committee on Science and Technology in Developing Countries operated through a central Secretariat in Chennai, India, supported by the Indian government, and through seven regional secretariats elsewhere in the world. Since its inception, the Committee on Science and Technology in Developing Countries has carried out a range of projects that have served to build science capacity in developing countries and to enhance international cooperation in science. Examples of the ways in which they have done this include providing travel funds for developing-country scientists to attend international scientific meetings, organizing topical regional workshops, and producing newsletters and publications on scientific issues relevant to developing-country scientists. The Committee on Science and Technology in Developing Countries was reviewed in 2001/2002 and, based on the review report [Report of the CSPR Panel for Review of the Committee on Science and Technology in Developing Countries (COSTED), 2002], the 27th General Assembly decided to replace it with four ICSU Regional Offices (in Africa, the Arab Region, Asia and the Pacific, and Latin America and the Caribbean; see Section 6.6), and a Policy Committee on Developing Countries (PCDC).

The goals of the Policy Committee on Developing Countries are to advise the Executive Board of ICSU on global trends and generic issues influencing the growth of science in developing countries, to increase participation of scientists and scientific organizations from developing countries in ICSU's programmes and activities, and to help ICSU strengthen science and capacity building in these regions through both cooperation between developed and less developed countries and cooperation among less-developed countries. Hence, there is clearly an overlap in the roles of the former Committee on Capacity Building in Science and the newly constituted Policy Committee on Developing Countries. However, capacity building is also of continuing concern to developed countries. Developed countries have strong national institutions, including some that are represented in ICSU that are able to address capacity-building issues.

This leads to the following recommendations:

20. *The Policy Committee on Developing Countries should coordinate closely with the Committee on Science Education in pursuing its functions.*

21. *The Policy Committee on Developing Countries should advise the Executive Board on major issues of capacity building in science not covered by the Committee on Science Education.*

6.6 ICSU REGIONAL OFFICES

The scientific capacity-building landscape of the developing countries is highly heterogeneous. However, there is some degree of homogeneity at the regional level in terms of ecological factors, science and technology resources, literacy levels, and socioeconomic drivers, for example. Many of the current challenges seeking solutions from science (climate change, sustainable development, desertification, coastal-zone management) demand solutions and actions that transcend national boundaries. Ecological and socioeconomic challenges are often regional, in contrast to governance and policy. Hence, a regional approach to capacity building in science – where there were sharing of resources, expertise, and experiences – would be more suitable and practical. At the same time, it is necessary to keep in mind that there might be regions that are geographically separated but are culturally, ecologically, or economically homogenous.

The ICSU 27th General Assembly of September, 2002, decided to establish four ICSU Regional Offices for Developing Countries. The roles of the Regional Offices have been broadly defined by ICSU as being to:

- Promote increased participation of developing country scientists and regional scientific organizations in ICSU programmes and activities; and to
- Assist ICSU in strengthening science and capacity building in developing countries through South-South and North-South collaboration.

Priority setting at the Regional Offices is envisioned to involve a consultative process of National Members and key organizations in non-member countries. As a first step, four regional workshops will be organized. Regional Committees will be created and, based on their results, a five-year strategic plan will be established for each Regional Office. In 2005, ICSU established a Regional Office for Africa at the National Research Foundation of South Africa (Pretoria). It is expected that the remaining offices will open in 2006. The Chairs of the Regional Committees are members of the Policy Committee on Developing Countries, thereby facilitating coordination.

The Regional Offices are therefore expected to have a crucial role in many aspects of ICSU's efforts in building scientific capacity in the identified regions, particularly in the developing countries therein. Hence, there is an overlap with functions of the former Committee on Capacity Building in Science. These considerations lead to the following recommendations:

22. *ICSU Regional Offices have a critical role to play in capacity building activities in the regional context. The ICSU family should help support this important new initiative in order for the offices to be successful.*
23. *Regional Offices should be encouraged to promote the linkages of regional centers of excellence in teaching, research, and information (libraries), in conjunction with the Academy of Sciences for the Developing World (TWAS), UNESCO, and the Third World Network of Scientific Organizations (TWNSO).*
24. *An important function of the Regional Offices could be the establishment of a Web-based information service in relation to fellowships and research grants.*
25. *Regional Offices should support South-South-North regional research and educational networks, since they provide platforms for collaborative efforts.*

6.7 ICSU/TWAS/UNESCO/UNITED NATIONS UNIVERSITY-INSTITUTE OF ADVANCED STUDIES VISITING SCIENTIST PROGRAMME

In 1990, ICSU, the Academy of Sciences for the Developing World (TWAS), and UNESCO established a short-term fellowship programme in basic sciences. It was aimed at promoting capacity building through international cooperation. It enabled young scientists from developing countries, and also from Central and Eastern Europe, to perform short-term studies in well-established scientific centers. In 2001, the ICSU Executive Board reviewed this programme and suggested that it should focus on least-developed countries. In 2003, it was decided to close down the programme, and to use the funds for strengthening the visiting-scientist programme.

The visiting-scientist programme supports visits of internationally renowned scientists to institutions based in developing countries, especially those in least-developed countries that have limited outside contacts. The purpose of the visit may be to lecture and/or conduct research. The programme excludes mathematics and physics, since the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy, operates a similar scheme for these two fields. In essence, the programme aims to help disadvantaged countries selectively expand their scientific base. The programme was initially supported by ICSU, the Academy of Sciences for the Developing World (TWAS), and UNESCO. In 2004, the United Nations University-Institute of Advanced Studies (UNU-IAS) joined as a fourth partner.

The visiting-scientist programme is a well-recognized approach to capacity building. However, the absence of support for scientists from developing countries to travel to advanced laboratories in more-developed countries as well as in less-developed countries is a gap that needs to be filled. It is also sensible to make optimum use of expertise and resources available in advanced developing countries in the region for capacity building, if only because this might prove more economical. Regional cooperation and networking will be critically dependent on funds being made available for this type of activity, the usefulness of which is well established in practice, and also recommended in the InterAcademy Council report.

This leads to the following recommendation:

26. *The ICSU-Academy of Sciences for the Developing World (TWAS)-UNESCO-United Nations University programme should seek additional resources to meet the needs of – and fellowships should preferably be given to – visits linked to research and education programmes with a regional focus.*

6.8 ICSU/UNESCO GRANTS PROGRAMME

Each year, a number of grants of up to US$100,000 each are awarded to ICSU Unions, Interdisciplinary Bodies or Joint Initiatives, often supported by National Members, for activities judged to be significant and of high priority. Themes given high priority include capacity building in science education. Additionally, the participation of developing-country and women scientists in the proposed activities is viewed favourably. Therefore, activities supported by the grants programme over the years have involved significant capacity building. Examples include a project to network African women physicists (by the International Union of Pure and Applied Physics, IUPAP, and National Members from Africa), and workshops in developing countries in utilizing satellite-derived space observation data for research (Committee on Space Research, COSPAR, and various National Members), which have subsequently developed research links between established scientists in developed countries and young scientists from the developing world. There is a need for additional funds to support this type of grant, which might in some instances be also be required to support some of the activities of the Regional Offices. Multi-national companies and charitable foundations are possible sources of additional funding for ICSU's capacity-building efforts.
This leads to the following recommendation:

27. *In the grants programme, high priority should be given to capacity building aspects in the broadest context. Attempts should be made to increase the funding base for this successful, competitive programme.*

6.9 SCIENTIFIC UNIONS

In response to a survey in connection with the Priority Area Assessment on Capacity Building, the Unions provided details of their activities related to capacity-building. (the material is available at www.icsu.org/8_teachscience/icsu-iap/teachingscience/accueilmembres.php4). The capacity-building efforts of the Unions are mainly – but not exclusively – directed towards postgraduate research students and practicing scientists. By exchange of experiences among Unions, examples of best practices could be developed. Union initiatives include:

- Creating Web sites from where subject-specific teaching material can be accessed.
- Establishing committees on education that have specific capacity-building initiatives (e.g., what is being done by the International Union on Pure and Applied Physics, IUPAP)
- Undertaking educational support activities at the level of National Member societies. These are mainly directed toward secondary schools. In particular cases (e.g., the International Union of Soil Sciences, IUSS), the Union coordinates activities undertaken by the national societies.
- Providing visiting lectureships and travel grants for participating in international meetings to developing-country scientists and postgraduate students.
- Supporting capacity-building workshops, scientific meetings, and training courses. An example is the workshop on Capacity Building in the Mathematical Sciences organized at the African Institute for Mathematical Sciences in Cape Town, in April, 2004, by the International Union of Theoretical and Applied Mechanics (IUTAM). The workshop enabled many African mathematicians to meet each other as well as world leaders in mathematical sciences.
- Publishing international journals and other publications to disseminate new scientific findings to the community, often through strong national memberships (e.g., the Radio Science Bulletin, published by the International Union of Radio Science, URSI, and Neurosciences published by the International Brain Research Organization, IBRO).

ICSU should identify mechanisms for supporting such activities, including special attention to possible tensions between the desire of Unions to promote discipline-relevant activities and the ICSU programmes and grants programme that emphasize cross-Union and cross-disciplinary collaboration as criteria for ICSU funding.

National scientific societies affiliated with many Unions are not established in many developing countries, and this has hindered the development of many scientific disciplines in those countries. Furthermore, the scientists in developing countries are isolated from international developments and from their colleagues in advanced countries. ICSU can play a role in addressing this defect, particularly through its Regional Offices. Scientific Unions also have access to experienced and interested scientists within their disciplines who are often willing to assist in capacity-building activities. This is an underutilized resource that – given the unique access of ICSU to Unions – has great potential to assist in capacity-building efforts, particularly through the Regional Offices.

This leads to the following recommendations:

28. *ICSU Unions should continue their efforts in capacity-building, based on extensive past and current efforts.*
29. *Unions should develop – individually, or in collaboration with other Unions – region-specific capacity-building programmes involving National Members and Regional Offices, including assisting with the establishment of new national scientific societies.*
30. *Unions should ensure that the ICSU/InterAcademy Panel Web portal on capacity-building is updated. Capacity-building activities by the Unions should take note of the different strategies developed by the Global Change SysTem for Analysis, Research, and Training (START).*
31. *The scientific expertise in the Unions should be made available for capacity-building efforts in different countries.*

6.10 NATIONAL MEMBERS

There were only a few responses from the National Members of ICSU in response to the recent survey on capacity building. This reflects a need to improve communication between ICSU and the National Members. The National Members contribute to capacity building in many ways:

- Through developing education policy for governments at the primary to tertiary levels.
- Developing materials for science teaching at the primary to tertiary levels.
- Researching and evaluating the state of science education in the countries.
- Promoting dialogue among scientists, government, the private sector, and the general public on important scientific issues of public interest.
- Playing a role in the public appreciation of science.
- Encouraging science education in primary and secondary schools by developing and publicizing new concepts, and by promoting excellence through the award of prizes to teachers and students in competitions.
- Maintaining information on national science and technology indices that reflect scientific capacity.

Such data may be collected by the ministries of science or by another government agency in the first instance, and subsequently acquired by the national members.

National Members, such as the Royal Society in the UK and the US National Academy of Sciences, have specific outreach programmes beneficial to developing countries. Collaboration among National Members in the context of the ICSU Regional Offices could provide opportunities for exchange of experiences and development of best practices.

The state of scientific development in different countries, as reflected in their science and technology indices, provides valuable information required for international capacity-building efforts. UNESCO collects this information regularly from the governments of member states, and the data provide an essential background for ICSU's own capacity-building efforts in science (See Recommendation 5).

There is a clear need for ICSU to make more effective use of the expertise and resources of the different national members in its capacity-building efforts. There is equally a need for national members to become more aware of international developments, concerns, and values in the area of capacity building, and to take the necessary actions among their scientists and scientific institutions to promote them.

This leads to the following recommendations:

32. *National Members should actively support the capacity-building activities of the Regional Offices.*
33. *National Members should be encouraged to collaborate within their regions on capacity-building needs and strategies.*
34. *National Members should reward scientific achievements, facilitate the public appreciation of current scientific issues, and promote the equitable involvement of women, young scientists, and minority communities in science.*

6.11 OTHER INTERDISCIPLINARY BODIES AND JOINT INITIATIVES OF ICSU

Capacity-building activities are generally ingrained in the activities of all the Interdisciplinary Bodies and Joint Initiatives. The mechanisms include:

- Organizing coordinated research programmes, scientific meetings, training courses, and workshops.
- Promoting the training of younger scientists, particularly from developing countries, and research students through coordinated research programmes. It is understandable that there is little interaction with primary, secondary, and tertiary educational programmes in the activities of the Interdisciplinary Bodies and Joint Initiatives, given the nature of their tasks.
- Interdisciplinary Bodies and Joint Initiatives play a role in capacity building through disseminating relevant scientific information through their Web sites and special publications.

However, as in the case of START (the SysTem for Analysis, Research, and Training for Global Change; see Section 6.3), there is a need for ICSU to take note of all the different capacity-building activities of the Interdisciplinary Bodies and Joint Initiatives. Better coordination in this sphere can help improve efficiency of the efforts. In particular, the Regional Offices of ICSU can perform an important role in facilitating the activities of the Interdisciplinary Bodies and Joint Initiatives. All Interdisciplinary Bodies and Joint Initiatives should be encouraged to make use of the proposed ICSU Web site on capacity-building activities other than science education (see Recommendation 15), modeling their activities on the successful capacity-building initiatives of START, and making optimum use of ICSU Regional Offices (see Recommendation 16).

6.12 AGENDA 21 AND THE UBUNTU DECLARATION

It is self-evident that our planet has only limited resources to support human activities. Therefore, the sustainable development of human societies is of over-riding importance to the future of the planet. Chapter 36 of Agenda 21, the action plan of the 1992 United Nations Conference on Environment and Development (un.org/esa/sustdev/agenda21.htm], affirms the importance of education in progressing towards sustainable development. UNESCO has been appointed as the task manager for Chapter 36. The years 2005-2014 have been declared by the UN General Assembly as the Decade of Education for Sustainable Development, with UNESCO to play the key role in promoting and implementing this (www.unesco.org/education/desd].

ICSU is a cosignatory with a number of other organizations, including UNESCO, to the Ubuntu declaration on Education and Science and Technology for Sustainable Development, which was signed at the 2002 World Summit for Sustainable Development (WSSD) (www.ias.unu.edu/research/Ubuntu.cfm]. ICSU has since participated in several follow-up meetings. In essence, the Ubuntu declaration calls upon educators, governments, and all relevant stakeholders to review the programmes and curricula of schools and universities in order to better address the challenges and opportunities of sustainable development. In preparing for the World Summit for Sustainable Development, ICSU convened a working group to draw up a document outlining the case for enhancing science education and capacity building, and proposing strategies for action (ICSU 2002. Science Education and Capacity Building for Sustainable

Development. ICSU Series on Science for Sustainable Development No. 5].

This leads to the following recommendation:

35. *The ICSU Committee on Science Education should take steps, in particular, to address the issue of science education for sustainable development, taking into account ICSU's commitments in this regard, e.g., the Ubuntu declaration.*

6.13 FORUM ON HIGHER EDUCATION, RESEARCH, AND KNOWLEDGE

In 2001, UNESCO, with the support of the Swedish International Cooperation Development Agency, set up the Forum on Higher Education, Research, and Knowledge as an open platform for dialogue and the exchange of views and experience among researchers, policy makers, and experts (www.unesco.org/education/researchforum]. The Forum is a follow-up to the World Conference on Higher Education, convened by UNESCO in 1998 (www.unesco.org/education], and to the World Conference on Science, convened by UNESCO and ICSU in 1999 (www.unesco.org/science/reports.html]. The Forum constitutes an open platform for intellectual exchange. The building blocks of this initiative are researchers and research. Every year, global Forum events are organized at UNESCO. Parallel meetings and activities are organized in the regions, contributing to shaping the agenda for the global discussions. At the global and regional gatherings, data and research are discussed by researchers, experts, and policy-makers from all parts of the world, so as to trigger critical interaction. These activities serve to highlight research and to bring out challenges facing institutions and countries. In this way, the Forum seeks to build on and complement existing and ongoing research, and to facilitate networking and synergistic partnerships among actors. The Forum has set up one global and five regional committees, and a permanent secretariat. ICSU has signed a memorandum of understanding with the Forum, and is working with the International Association of Universities to promote the linkage of higher education with scientific research. The Forum is mandated to encourage capacity building in scientific research, an area that is also clearly within the sphere of operation of ICSU.

This leads to the following recommendation:

36. *ICSU should strengthen its involvement with the UNESCO Forum on Higher Education, Research and Knowledge, with particular emphasis on the study of research systems. The Regional Offices should be encouraged to collaborate with the Regional Committees of the Forum.*

6.14 REPORTS OF THE CSPR ASSESSMENT PANELS ON ENVIRONMENT AND ITS RELATION TO SUSTAINABLE DEVELOPMENT AND ON DATA AND INFORMATION

In the report of ICSU's Committee on Scientific Planning and Review Panel on Environment and its Relation to Sustainable Development, the Panel commented on capacity building for research on environment and sustainable development. Specifically, it noted the need for formal training in the environmental area at all levels, with more emphasis on young people to undertake research at the masters and doctorate levels. The fragmentation of environmental issues into traditional disciplines in universities was considered disadvantageous. In the context of capacity building, the report also called for improving links between scientists and policy makers, greater application of research findings in planning and national policies, and greater involvement of health scientists, technologists, and social scientists in environmental and sustainable-development activities. The report also commended the capacity-building approach taken by SysTem for Analysis, Research, and Training for Global Change (see Section 6.3), and noted the need for improving its funding base.

The report from the Priority Area Assessment on Scientific Data and Information recommended that ICSU take action on capacity building in the area of data and information. The Panel has considered the state of scientific data centers in the world. UN bodies, such as the World Health Organization, the Food and Agriculture Organization, and the World Meteorological Organization, are involved in collecting and maintaining records of health, agriculture/food, and climatological data. However, there is a need to consider how other data pertaining to science can be collected, stored, and made internationally available. ICSU has a unique role to play in promoting this activity. The accessibility of important scientific data is particularly important for advancing science in developing countries, and therefore falls within the area of capacity building.

Appendix 1. Terms of Reference for the ICSU Priority Area Assessment on Capacity Building in Science[1]

1. INTRODUCTION

The goal of the Priority Area Assessment (PAA) process is to strengthen ICSU's overall capability in addressing priority scientific issues that are of emerging importance to science and to society at large. The PAA is a mechanism to develop ICSU's strategies for selected priority scientific areas. It is designed to help ICSU develop a programme structure reflecting its priorities, to ensure synergies in the activities of the ICSU family, and to enable an appropriate allocation of limited resources. In order to be effective, the PAA process must involve relevant members of the ICSU family: i.e., Union and National Members, Interdisciplinary Bodies, and Joint Initiatives. It should also consider ICSU's priorities in the context of relevant activities outside of ICSU.

The immediate outcome of a PAA is a report containing key recommendations that will be published and widely disseminated by ICSU. This report will form the basis for future actions by ICSU and ICSU members, including the development of new programmes, policy initiatives and definition of new priorities for the ICSU grants programme. Some of the recommendations may require the establishments of new partnerships with bodies outside the ICSU family or may be more appropriately taken forward by other organizations, in which case the necessary dialogue(s) will be initiated. The results of the PAA will provide essential input for the development of an ICSU strategy to be presented at the 28th General Assembly in October 2005.

2. CONTEXT FOR THE PAA ON CAPACITY BUILDING IN SCIENCE

Scientific and technological capacity of individuals is increasingly called for as a basis of prudent private and public decision-making for our sustainable future. Abilities to create, synthesize and apply scientific and technological knowledge are crucial for peaceful development of the global society in the 21st century. However, securing high-quality human resources with strong scientific and technological talent is one of the major challenges to all societies of the world. Attracting young talent to science, improving the quality of science education, and enhancing public appreciation of science are, among others, emerging priority issues of governments of both developing and developed countries. In particular, there is a pressing need for capacity building in developing countries where poor education in general is an inexorable problem. However, the decreased attraction of science and engineering careers of youth in industrialized countries is also cause for concern.

Capacity building in science does not only mean training of people, but also has institutional and other implications. It should also concern not only scientists or scientists to be, but also other groups of individuals in the society. Capacity building in science should be the continuous effort that leads to the establishment of a corps of qualified scientists with supporting infrastructure, including facilities and working conditions, which enables them to conduct research, education, training and advisory work, particularly in areas of direct societal significance[2].

The responsibility for building and maintaining capacity lies squarely on the shoulders of national governments, but requires significantly enhanced collaboration and partnerships with the private sector, the global development assistance community, and the S&T community. The United Nations, together with their partner organizations, has been advocating the collective responsibility of the global society for capacity building for sustainable development. On the occasion of the World Summit on Sustainable Development (WSSD), ICSU, representing the international scientific and technological community together with other partners, has successfully highlighted the importance of capacity building in science for sustainable development[3]. At CSD11, discussing the follow-up to WSSD, ICSU was successful in promoting "education" as a cross-cutting theme and in giving recognition to this group equal to the official major groups, of which the Science and Technology Community is one. ICSU, having the strengthening of human and physical scientific resources worldwide with particular emphasis on the developing world as one of its major objectives, is expected to continue playing a leading role in this area, in partnership with other international, regional, and national organizations.

Amongst many inter-governmental organizations, UNESCO will continue to be a major partner of ICSU in

Footnotes:

1 - Other PAAs are also being initiated in the area of "Environment in Relation to Sustainable Development" and "Scientific Data and Information."

2 - The working definition of "Capacity Building" developed by the ICSU Advisory Group on the Possible Role of ICSU in the Areas of Capacity Building in Science and of Science Education in 1992. The group was called partially as a follow-up to UNCED. Based on the recommendation of the group, the 24th General Assembly in 1993 established the Committee on Capacity Building in Science (CCBS), replacing the Committee on Teaching of Science.

3 - ICSU 2002. ICSU Series on Science for Sustainable Development No. 5: Science Education an Capacity Building for Sustainable Development.

the area of capacity building in science. For example, the UNESCO Science Sector is initiating a brain-storming debate on strategies for strengthening international co-operation in basic science involving ICSU. The Education Sector organized the Higher Education Partners' Meeting (WCHE+5) in June, 2003, to review the progress and follow-up strategies to the World Conference on Higher Education (WCHE). WCHE+5 concluded that science and higher education policies must be integrated focusing on the role of universities both for higher education and scientific research. Such collaboration will be extremely useful in defining ICSU's role in the capacity building in science in a broader context.

The InterAcademy Council has initiated a project designed to produce a global strategy for improved access by all nations and peoples to the benefits of science and technology. The focus will be on human resources, research institutions, scientific cooperation, and global communication. The final report will be issued to a wider audience including international organizations, in particular, appropriate UN agencies. A draft report will be made available for consultation in September, 2003, which would serve as a part of background for this assessment.

Recognizing the importance of capacity building in science and the role of ICSU therein, the 27th General Assembly (GA) of ICSU encouraged the ICSU family members to intensify their efforts in effecting partnerships within and beyond the ICSU family to strengthen capacity building, especially for developing countries, and to broaden outreach to teachers and young scientists. In this connection, the GA also decided to continue the mandate of the Committee on Capacity Building in Science (CCBS) only for one year. The GA also decided to dissolve the Committee on Science and Technology in Developing Countries (COSTED), and to set up a Policy Committee on Developing Countries and four ICSU Regional Offices for developing countries. The PAA on Capacity Building in Science is expected to develop strategies for bringing synergies to a wide range of capacity building activities of the ICSU family, and provide inputs to future discussions on the future course of the CCBS.

3. SCOPE OF THE PAA ON CAPACITY BUILDING

The scope of the PAA should cover a wide range of capacity-building activities carried out by the ICSU Unions and National Members and Interdisciplinary Bodies, to provide an overall picture of those activities and propose action to strengthen synergies among them. The PAA should also take into account relevant efforts made by outside organizations and identify value-added role of ICSU and ways to develop partnership with other organizations, not only in the science sector but also other sectors such as education and development aids sectors, to complement each other.

4. MAJOR ICSU ACTIVITIES IN RELATION TO CAPACITY BUILDING

A one-day special session was held on the occasion of Unions Presidents Meeting in February, 2001, inviting representatives of the ICSU Interdisciplinary Bodies, to exchange information on their major capacity building activities. As illustrated later also by a draft compendium on capacity building[4]. A wide range of capacity-building activities are being carried out by the ICSU family: ICSU Unions Members, National Members, and Interdisciplinary Bodies. In particular, many of the Scientific Unions are actively engaged in a wide variety of educational activities in respective disciplines. The following are only selected examples of capacity-building activities of the ICSU family.

The Committee on Capacity Building in Science (CCBS) was created in 1993 with the mandate covering the following three areas: i) primary school education in science and mathematics, ii) the public appreciation of science, and iii) the isolation of scientists. Over the past few years, CCBS has been focused on science and mathematics education at the primary, secondary, and tertiary levels mainly thorough the organization of international conferences to exchange best practices on curriculum development, hands-on science education programmes and other ways to ensure quality of science and mathematics education. These conferences contributed to connecting the science and education communities, in particular, in the host country of the conference. For example, the CCBS conference held in China in 2000 has also served as an opportunity to launch reform efforts in primary school efforts in primary science. In addition, the CCBS, in association with IAP, is developing a functional Web site linking relevant home pages of organizations/programmes. The 27th GA decided to continue the mandate of CCBS only for one year (until the end of 2003).

The Committee on Science and Technology in Developing Countries (COSTED) was established in 1966 and for decades has carried out a range of projects to facilitate participation of developing countries' scientists and to strengthen the scientific and technological capacity of developing countries through the work of its Central Secretariat in India and seven regional secretariats. An in-depth review of COSTED was carried out in 2001-2002, and based on recommendation from this review, the 27th GA decided to replace the seven regional secretariats by four ICSU Regional Offices in Asia, Africa, Latin America and Caribbean, and Arab Region.

The ICSU/TWAS/UNESCO Short-Term Fellowship

Footnote:

4 - ICSU, 2001. ICSU Compendium of Capacity Building Activities (draft).

programme in the Basic Science, originated in 1990, aims at promoting capacity-building through international cooperation in the basic sciences. Specifically, it is enabling scientists, particularly young scientists from developing countries and Central and Eastern Europe, to carry out short-term studies in well-established scientific centers. The ICSU Executive Board recently reviewed the programmes and suggested that they should focus more on the least-developed countries. ICSU's longer-term role in this programme should be considered in the context of the PAA.

The Global Change SysTem for Analysis, Research and Training (START), a programme of the Earth System Science Partnership (ESSP), established in 1992, developed a system of regional networks of collaborating scientists and institutions on global change issues. Its objective is to build indigenous capacity, especially in developing countries, to address scientific and policy aspects of global change by strengthening and connecting existing institutions, training scientists and providing them with improved access to data and research results.

The International Network for the Availability of Scientific Publications (INASP), a programme of the Committee on Dissemination of Scientific Information (CDSI), was established in 1992 in cooperation with UNESCO and TWAS. It is a cooperative network of partners the aim of which is to enhance worldwide access to scientific information, and to improve its flow within and between countries, especially those with less developed systems of publication and dissemination. There are many other ICSU subsidiary bodies that have capacity building activities focusing on research capacity building in specific areas in developing countries.

5. TERMS OF REFERENCE

The Panel will:

1) Define an overarching "mission" and the added value of ICSU involvement in the area of the Capacity Building taking into account relevant activities outside of ICSU;

2) Propose a strategic framework for ICSU to take this area forward for the next 5-10 years;

3) Examine current activities within the ICSU family, identify gaps, overlaps and synergies among existing activities and possibly propose new responsibilities for individual bodies;

4) Propose modalities for promoting collaboration and co-ordination within the ICSU family when necessary and propose potential partnerships with bodies outside ICSU;

5) Examine and propose, if appropriate, changes either in the future direction of individual bodies and/or their activities, including relationships with other bodies/organizations;

6) Review the activities of the ICSU Scientific Unions and propose, if necessary, ways to strengthen interaction among themselves and also with interdisciplinary bodies and joint initiatives.

6. WORK PLAN

A minimum of two physical meetings of the Panel might be expected in addition to "virtual" discussions via e-mail and telephone. Input from the relevant members of the ICSU family will need to be solicited and analyzed; it may be desirable to conduct "face-to-face" interviews with representatives of key bodies.

The Panel will be asked to prepare a report to the ICSU Committee on Scientific Planning and Review (CSPR), which will include an overarching mission statement and strategic framework for ICSU and recommendations on roles of new and/or existing interdisciplinary bodies and joint initiatives in the area. This report will be published.

7. RESOURCES

ICSU will provide financial resources to carry out the review, including travel and accommodation costs for the Panel members to participate in the necessary meetings. The ICSU Secretariat will provide administrative support to the Panel, including assistance with communication among the members and organization of meetings. The final report will be the responsibility of the Panel, although the ICSU secretariat will assist in its preparation as necessary.

Appendix 2. List of Panel Members Priority Area Assessment on Capacity Building in Science

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ICSU mission statement

In order to strengthen international science for the benefit of society, ICSU mobilizes the knowledge and resources of the international science community to:

Identify and address major issues of importance to science and society

Facilitate interaction amongst scientists across all disciplines and from all countries

Promote the participation of all scientists – regardless of race, citizenship, language, political stance, or gender – in the international scientific endeavour

Provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector.

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