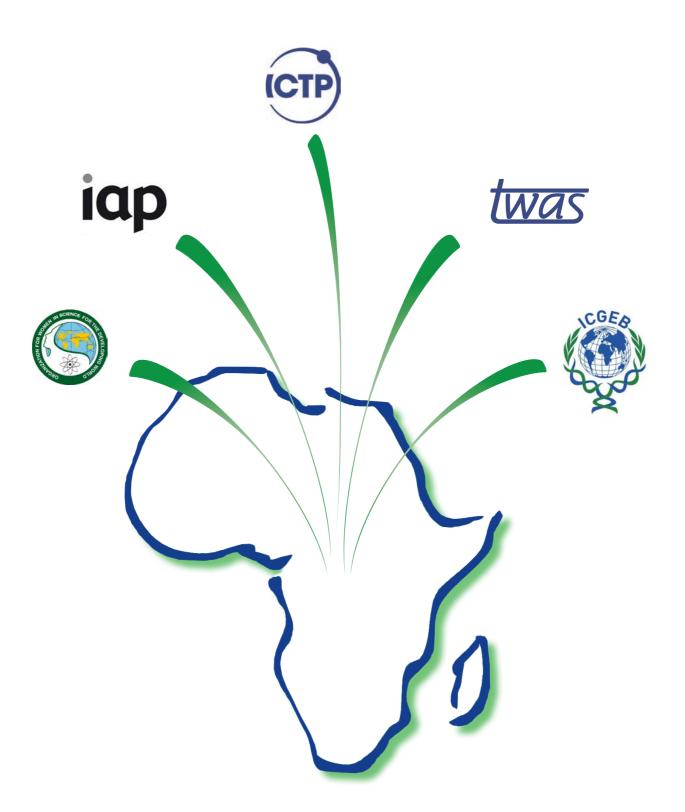
Building Science Capacity in Africa



A 10-year overview of support to African science through the Trieste-based science institutions

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Foreword

The government of Italy supports a unique system of international science institutes that for decades has focused its energy on building scientific capacity in Africa and other developing regions. Located in Trieste – Italy's "City of Science" – and active members of that city's "Trieste System", the five organizations play a crucial role on behalf of Italy by using their extensive networks of scientists and partner institutes to implement innovative, high-impact scientific support activities.

The five organizations include: the Abdus Salam International Centre for Theoretical Physics (ICTP); the International Centre for Genetic Engineering and Biotechnology (ICGEB); The World Academy of Sciences (TWAS); the Organization for Women in Science for the Developing World (OWSD); and the InterAcademy Partnership (IAP). All share a common mission: to develop and maintain a critical mass of highly qualified, innovative scientists in developing countries. The support they provide includes fellowships, grants, conferences, mentoring, networking, sabbatical opportunities and much more.

All five institutions have been particularly active in Africa, and for good reason: while countries such as Brazil, India and China have made great strides in developing science and technology in their countries, Africa continues to lag in key development indicators such as investment in R&D and higher education. Indeed, of the 47 UN-designated Least Developed nations worldwide, 33 are in Africa.

As this report shows, over the past decade the five institutions have contributed to African science development in important ways:

- ICTP is active in all 54 African countries, where it has held over 200 scientific meetings. More than half of its postgraduate students are from Africa, and 6730 African scientists were trained through ICTP activities in Trieste;
- TWAS awarded 590 PhD fellowships and 120 postdoctoral fellowships to young African scientists;
- 86% of OWSD's PhD fellowships went to African women;
- IAP supported the creation of 15 new national science academies;
- Active in 27 African nations, ICGEB awarded 120 PhD and postdoctoral fellowships and 30 grants, held 35 meetings and hosted 5000 paticipants and 100 nationals in its Cape Town labs.

In addition to sharing support from Italy, the five institutions have another common characteristic: they operate under the United Nations umbrella. As such, they actively strive to achieve the 17 Sustainable Development Goals (SDGs) outlined in the UN's Agenda 2030. The institutes share an understanding that the SDGs simply cannot be achieved without the support of science, social sciences and technology.

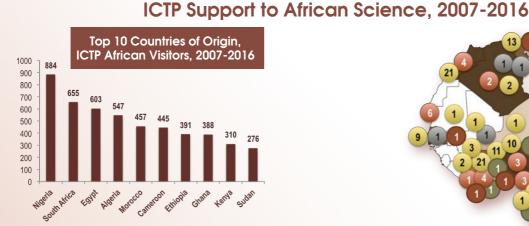
As a common heritage of all humankind, scientific knowledge can be used as an effective engine for national development by disadvantaged countries. However, to fully exploit all that science can offer, Africa needs to build and sustain scientific capacity, both at the individual and institutional level. Thanks also to the financial support of the Italian government, these five institutions contribute to empower Africa to achieve many of the SDGs.

This report highlights the five institutions' activities and achievements in support of African science over the past 10 years. Each institute, in its own way, has contributed key assistance to scientists in the South. The impact of their initiatives goes far beyond the charts and graphs presented here: they also build scientific careers, and create positive changes in the lives of individual African researchers. Therefore, where possible, we have included stories of African scientific activities of the Trieste System.



Abdus Salam International Centre for Theoretical Physics

ICTP conducts physics and mathematical research and training in support of building sustainable science in the developing world.



ICTP and Africa by numbers

- 6,730 scientific visitors (22% women)
- 780 visitors in 2016 (25% women)
- 50 countries represented (56% from LDCs)
- 53 training activities in the region
- 3 ICTP awards to distinguished scientists

- ICTP Schools, Workshops (53)
- ICTP-OEA Affiliated Centres (6)
- OICTP-OEA Projects (11)
- ICTP-OEA Networks (6)
- ICTP-OEA Scientific Meetings (181)



Maryse Knoua ICTP Postgraduate Diploma Student, 2010-2011 ICTP TRIL Fellow, 2011 Currently at University Marien Ngouabi, Brazzaville, Congo



Kofané Timoléon Crépin ICTP Associate, 2008-2016 2014 Kwame Nkrumah Continental Scientific Award, by the African Union

ICTP activities in Africa

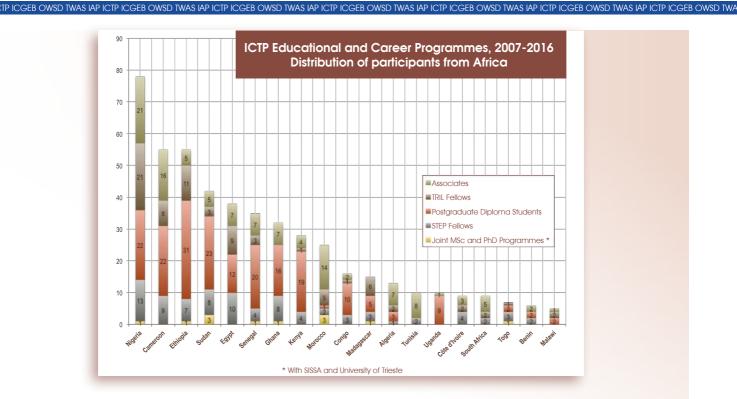
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African

Amna Abdalla Mohammed Khalil ICTP Postgraduate Diploma Student, 2010-2012 Einstein Forum Ambassador for Sudan

ICTP—East African Institute for Fundamental Research

ICTP, in partnership with the Rwandan government, has created the ICTP - East African Institute for Fundamental Research (ICTP - EAIFR), a Category 2 UNESCO institute in Kigali, Rwanda.





Highlights of ICTP Projects for African Scholars

	Project	Impact
	"Strenghtening Training Capacity in Wireless Networking in Africa" ICTP-UNECA Small Island Developing States Project Workshops and Direct Engineering assistance	Disseminated Wireless Training Kits, including wireless devices, training materials for lectures and related exercises, in Rwanda and Senegal. Special focus was provided on climate information services applications in Cape Verde, Comoros, Guinea-Bissau, Mauritius and Seychelles. Fourteen workshops were organized from 2012 to 2016 in 13 African countries.
	EU FP7 project "Quantifying Weather and Climate Impacts on Health in Developing Countries" (QWeCI)	Developed 162 Km WiFi link for rural telemedicine to connect the Univ. of Malawi in Blantyre with the Mangochi Hospital to help predict outbreaks of vector-borne diseases.
	High performance and grid computing for scientists in Africa	Organized training activities in the areas of High Performance Computing and grid computing through Master's programme, at Addis Ababa University to create computational physics centre in Africa.
	Joint EC-ICTP project Training EGNOS GNSS in Africa (TREGA)	Trained 32 professionals from 19 African countries. Ten of those trainees employed at the EGNOS-Africa Joint Project Office (JPO) in Dakar, Senegal. Out of 100 papers published by African scientists, 84 were written by those who participated in ICTP related activities.
	Establishment of a Centre of Excellence in Internet of Things	ICTP, as an international partner, assisted the University of Rwanda in establishing the first CoE in IoT with the support of the World Bank.



The World Academy of Sciences

TWAS supports sustainable development through research, education, policy and diplomacy.



Quarraisha Abdool Karim, South Africa, winner of the 2014 TWAS-Lenovo Science Prize, HIV/AIDS research.



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TWAS Fellows: the Pinnacle of Excellence

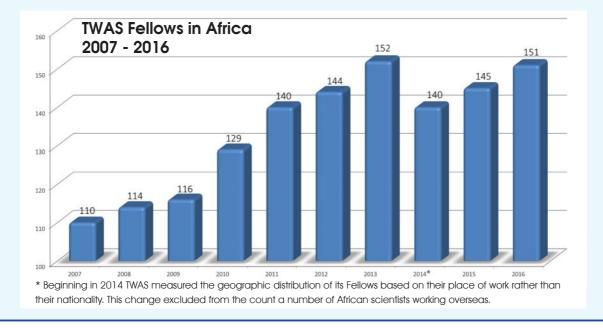
Moctar Toure, Senegal, TWAS vice president, leader in African food security and agriculture policy.



Akissa Bahri, Tunisia, water security expert, former coordinator at African Water Facility.



Keto Mshigeni, Tanzania, former TWAS vice president, leading food security expert and science advocate.



Building African Careers

For a growing number of young African scientists, TWAS provides stepping stones to a high-impact career. Chemist Emmanuel Unuabonah progressed from a TWAS PhD Fellowship in 2005 to win two TWAS research grants. Today he is a specialist in water purification at Redeemer's University in Nigeria. Six of his master's degree students are planning to pursue PhDs.





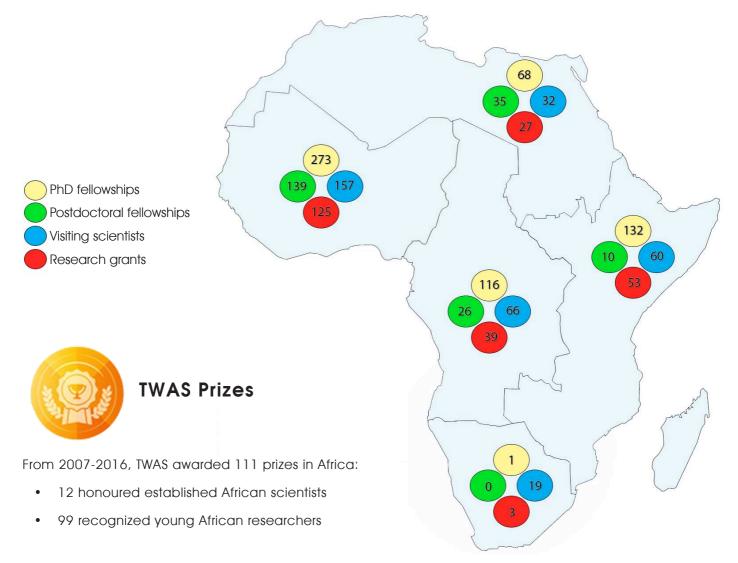






TWAS Research and Training Support for Africa: 2007 - 2016

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Cooperation and Science Diplomacy

* **2017** – TWAS helped to organise the Conference on Climate, Ecosystems and Livelihoods for Africa in Nairobi, Kenya. Seventy scientists and policy leaders from 10 African nations and China attended.

* **2016** – Kigali, Rwanda, hosted the 27th TWAS General Meeting. Rwandan President Paul Kagame delivered the keynote address.

* 2014-2016 – Twenty-seven African scientists and policymakers attended the annual AAAS-TWAS Summer Course



in Science Diplomacy, in Trieste, Italy.

* **2014** – The Italy-Africa Day celebrated three decades of cooperation in building African research. Federica Mogherini (left), then Italy's Minister of Foreign Affairs, delivered the keynote address.





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Organization for Women in Science for the Developing World

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OWSD provides research training, career development and networking opportunities for women scientists throughout the developing world at different stages in their careers.



Linda Dyorisse Nyamen, Cameroon PhD in Chemistry Graduated in 2013 OWSD Fellowship at the University of Zululand, South Africa now Senior Lecturer in Inorganic Chemistry University of Younde I Cameroon



Grace Ofori Sarpong, Ghana Recipient of the 2016 OWSD-Elsevier Foundation for Early Career Women Scientists in Engineering, Innovation and Technology



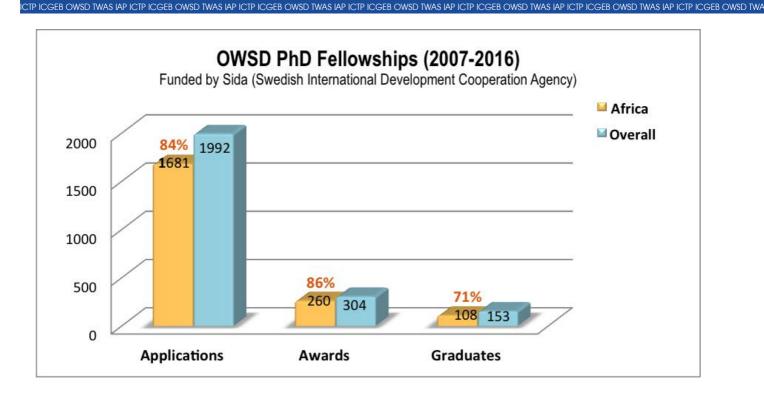
Jennifer Thomson, South Africa Biotechnologist specialized in drought, resistance maize/food security OWSD President 2016-2020

19%• Nigeria5%• Sudan5%• Ghana3%• Ghana3%• South Africa3%• Uganda3%• Other Regions

OWSD-Elsevier Foundation Awards

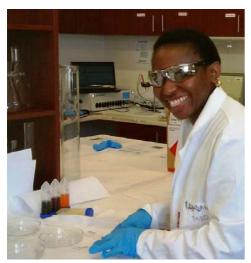
2011-2016

OWSD-Elsevier Foundation Early Career Awards to outstanding women scientists from developing countries. Since 2011, OWSD has awarded this prestigious prize to 7 women from Nigeria, 2 from Sudan, and one each from Egypt, Ghana, South Africa and Uganda. 36% of all the awards offered have gone to Africans.

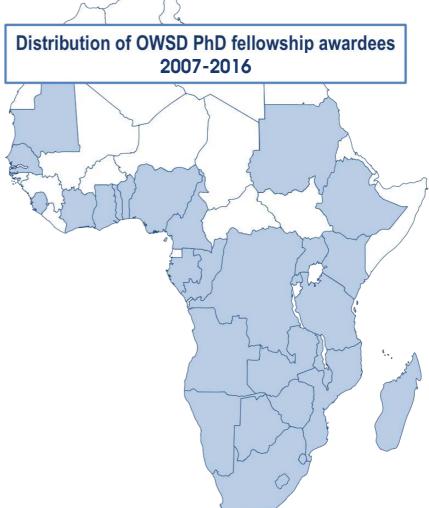


Top 5 African Countries			
Country	PhD Fellowship awardees*	PhD Graduates	
Nigeria	54	32	
Sudan	36	15	
Cameroon	31	12	
Kenya	20	8	
Zimbabwe	19	8	
Total	160	75	

 \star including graduates and fellows who are still completing their PhDs



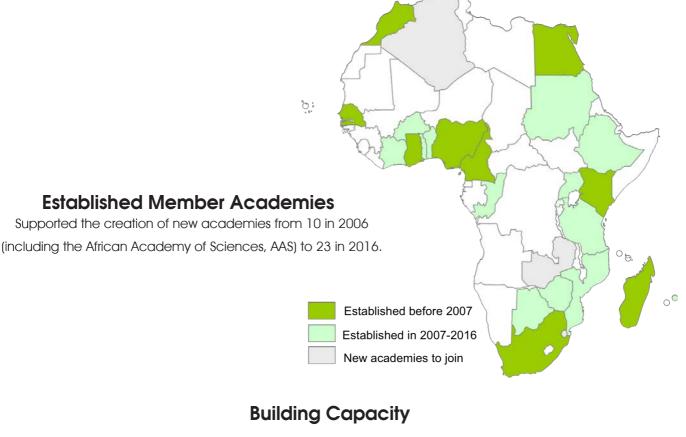
Agnes Mbonyiryivuze, Rwanda PhD Fellow in Physics University of Cape Town

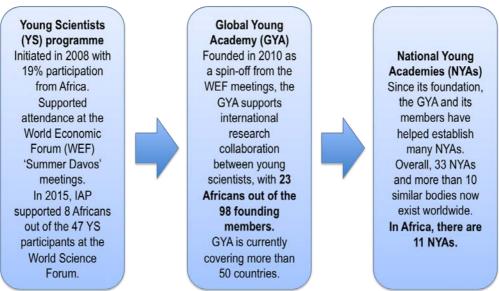




The InterAcademy Partnership

IAP is committed to making the voice of actionable science heard on issues of critical importance to the future of humankind.





Training of Young Physician Leaders (YPL) through a series of workshops and sessions at the annual World Health Summit in Berlin, and active networks for the YPL alumni.

Since 2011, the programme has trained 159 young physicians (under the age of 40), of whom 36 are African. 7 out of 25 alumni convened at 69th World Health Assembly of WHO, May 2016, were African.

Academy Outcomes

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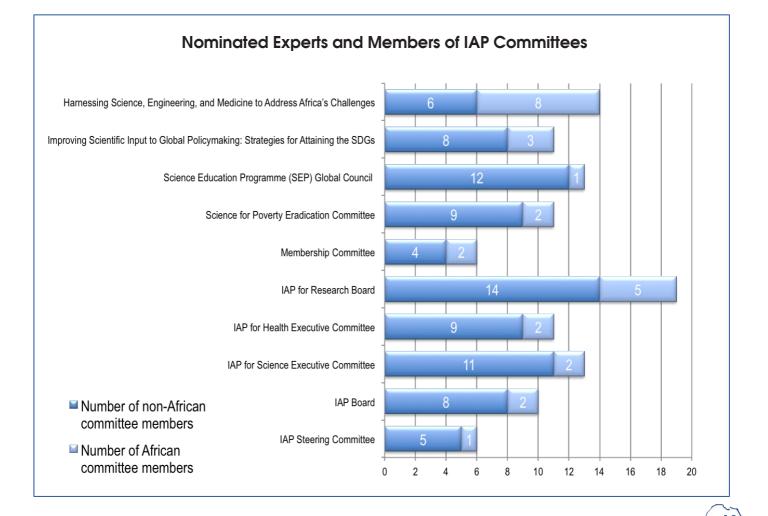
Statements and Recommendations to Policy Makers, Reports and Thematic Meetings through the Network of African Science Academies (NASAC) and other African academies

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Developing Knowledge

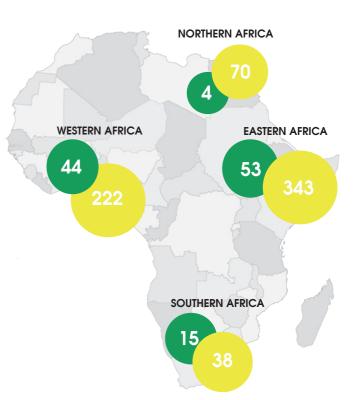
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ICGEB is a Cente of excellence for research, training and technology transfer to industry in the field of biotechnology to promote sustainable global development with advanced research laboratories in Trieste, New Delhi and Cape Town, and over 600 scientists active in 47 research groups. It has 9 Affiliated Centres in as many African countries.



Agreements with Industries			
Type of Agreement	Subject	Country	
Tech Transfer	Production of EPO	Egypt	
Tech Transfer	Production of Hepatitis B Vaccine	Egypt	
Tech Transfer	Production of G-CSF	Egypt	
Tech Transfer	Production of EPO+G-CSF +IFNalpha	Egypt	
Tech Transfer	Production of EPO	South Africa	
Tech Transfer	Production of HIV/AIDS Diagnostics	Nigeria	
Tech Transfer	Diagnosis of Chronic murine schistosomiasis	South Africa	





Map shows the number of Biosafety events (green) and participants and speakers therein (yellow). The Biosafety Group trains legislators involved in the regulation of GMOs in agriculture across 27 African nations.

Collaboration			
Collaboration	Subject	Country	
EU 7th Framework Programme	BioProtech	Tunisia	
EU 7th Framework Programme	GRACE: GMO risk assessment	South Africa	
EU Horizon2020 Project	STARBIOS2	South Africa	
WHO	Poliovirus	Nigeria	
Biotech Development	Production of Biosimilars	South Africa	



Countries of origin and destination of awardees supported by the ICGEB SMART Fellowships Programme supporting South-South Mobility

ICGEB African Member States (19) blue. Collaborating African countries (17) dark grey & light blue. ICGEB Host Laboratories (3) yellow.

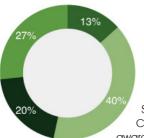
Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Congo, D. R. Congo, Côte D'Ivoire, Egypt, Eritrea, Ethiopia, Ghana, Kenya, Lesotho, Liberia, Libya, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Rwanda, Senegal, South Africa, Sudan, Swaziland, Tanzania, The Gambia, Tunisia, Uganda, Zimbabwe

African Fellows in ICGEB labs (*externally funded) in 2016			
Botswana]*	Nigeria	9
Burundi	۱	South Africa	1+11*
Cameroon	5+4*	Tanzania	1
Egypt	4+1*	Tunisia	1
Kenya	2	Zimbabwe]*
Overall Total 19+17*			

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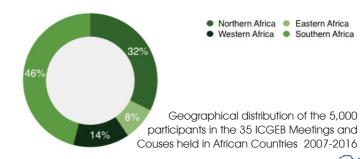
The Arturo Falaschi Fellowships in 2007-2016 (on ICGEB Core Funds)			
Country	Awarded	Country	Awarded
Burundi	2	Morocco	4
Cameroon	9	Nigeria	21
Egypt	11	South Africa	2
Kenya	8	Sudan	4
Libya	1	Tanzania	6
Mauritius	2	Tunisia	2
Overall Total 72			

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Scientific classification of the 30 ICGEB Collaborative Research Proposal Grants awarded to Africa for the period 2007-2016



ICTP

For more than 50 years, the Abdus Salam International Centre for Theoretical Physics (ICTP) has been a driving force behind global efforts to advance scientific expertise in the developing world.

CTP ICGEB OWSD TWAS IAP ICTP ICGEB OWSD TWAS IAP ICTP

Founded in 1964 by the late Nobel Laureate Abdus Salam, ICTP provides scientists from developing countries with the continuing education and skills that they need to enjoy long and productive careers. ICTP is governed by UNESCO, the IAEA and Italy, and is a UNESCO Category 1 institute.

ICTP pursues scientific excellence in a variety of fields, including:

- High Energy, Cosmology and Astroparticle Physics
- Condensed Matter and Statistical Physics
- Mathematics
- Earth System Physics
- Applied Physics
- Quantitative Life Sciences

At ICTP, scientists from developing countries have a number of academic, training and sabbatical opportunities. These include a pre-PhD Postgraduate Diploma Programme and PhD programmes run jointly with Trieste universities.

ICTP also provides training at laboratories in Trieste and throughout Italy, as well as study and sabbatical visits ranging from weeks to years. Educational opportunities are further enhanced by ICTP's annual programme of more than 60 international conferences and workshops held in Trieste and abroad.

ICTP alumni serve as professors at major universities, chairpersons of academic departments, directors of research centres and ministers of science and technology in nations throughout the developing world. Many of them have been recognized in their own countries and internationally for their contributions to science and science policy. The impact of ICTP extends well beyond the Centre's facilities to virtually every corner of the Earth.

TWAS

The World Academy of Sciences for the advancement of science in developing countries – TWAS – supports sustainable development and prosperity through research, education, policy and diplomacy.

TWAS was founded in 1983 by a distinguished group of scientists from the South, under the leadership of Abdus Salam, the Pakistani physicist and Nobel laureate, with support from Italian physicist Paolo Budinich. They shared a belief that science and technology could drive economic development in poor nations and help them to address challenges such as hunger, disease and energy.

Many countries in the South have since made remarkable progress in building research capacity, but others are lagging. Today, the Academy's work is focused especially on the 47 Least Developed Countries, 33 of which are in Africa.

TWAS has some 1,200 elected Fellows, including 15 Nobel laureates. They represent the pinnacle of scientific

achievement in the developing world. In addition, TWAS has more than 250 current and former Young Affiliates. It is based in Trieste, Italy, on the campus of the Abdus Salam International Centre for Theoretical Physics (ICTP). TWAS hosts the Organization for Women in Science for the Developing World (OWSD), with over 6,000 members; the GenderInSITE project; and the InterAcademy Partnership (IAP), the voice for more than 130 science and medical academies worldwide.

The government of Italy provides core funding, and has been a steadfast partner throughout the Academy's history. The Swedish International Development Cooperation Agency (Sida) provides essential programmatic funding. TWAS is a programme unit of UNESCO, which administers its finances and personnel.

OWSD

The Organization for Women in Science for the Developing World (OWSD) is an independent, non-profit and non-governmental body based at the offices of TWAS, in Trieste, Italy.

OWSD was founded in 1987 and is the first international forum to unite eminent women scientists from the developing and developed worlds to strengthen their role in the development process and promote their representation in scientific and technological leadership.

OWSD provides research training, career development and networking opportunities for women scientists throughout the developing world at different stages in their careers.

Our main programmes are:

- Scholarships called 'OWSD Fellowships' for women scientists from least developed countries to study for postgraduate (MSc/PhD) degrees in another developing country;
- Awards to recognize and celebrate early career women scientists who have made significant contributions to research and education in their scientific field.

In addition, OWSD provides support to women scientists throughout their careers:

- Networking: OWSD has more than 4,000 members, of whom over 90% are women living and working in developing countries who have masters or doctorates in science subjects.
- Career Development: As you progress from undergraduate science through to PhD research, to postdoctoral
 studies and beyond, you can draw on OWSD members' experience and expertise to help you through to the next
 stage of your career. You can attend regional and international conferences and seminars in your research field,
 develop writing and presentation skills, sign up to get help from a mentor, learn what it takes to become a leader
 or negotiate better conditions in your department.

IAP

The InterAcademy Partnership (IAP) gives voice to more than 130 national, regional and global academies of science and medicine covering some 95% of the world's population. By bringing together such academies, IAP is able to:

• harness the power, authority, independence and credibility and to access their combined scientific expertise; and

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• provide them with a collective mechanism and support to further strengthen their crucial roles as providers of evidence-based policy and advice to citizens and public officials on the scientific and health aspects of critical global challenges.

IAP focuses on four strategic priorities:

- Developing a scientifically literate global society;
- Providing evidence-based advice and perspectives on global issues;
- Strengthening the global scientific enterprise for example by supporting young scientists, promoting the role of women in science, and promoting responsible research practices; and
- Strengthening the global network, including supporting the creation of new academies in countries where they are not yet present.

IAP is formed of three inter-related established networks of academies, namely IAP-for-Science, founded in 1993; IAP-for-Research, founded in 2000; and IAP-for-Health, also founded in 2000. IAP also acts through four regional networks:

- the Network of African Science Academies (NASAC), for Africa, established in 2001;
- the Association of Academies and Societies of Asia (AASSA) for the Asia/Pacific region;
- the European Academies Science Advisory Council (EASAC) for Europe; and
- the Inter-American Network of Academies of Science (IANAS), for the Americas.

ICGEB

ICGEB is an intergovernmental research organisation operating within the United Nations Common System. Established in 1987, with headquarters in Trieste, it counts over 60 Member States and remains unique in pursuing its goals through advanced experimental research undertaken in its own laboratories. Prof. Lucy Ogbadu, Director-General and CEO of NABDA, NIgeria, is currently the Vice-President of the Board. Six African scientists (4 of whom women) have served on the Scientific Council.

ICGEB's network:

- comprises world experts in fundamental fields of the life sciences including agricultural biotechnology, communicable and non-communicable diseases, nutritional improvement of crops and the regulation of science and technology.
- raises awareness and promotes policies and operations compatible with sustainable development.
- disseminates scientific knowledge and concepts.
- facilitates exchanges across scientific disciplines.
- produces excellent research.
- champions international cooperation across unique technological and educational platforms.
- represents an effective means of promoting global growth and ensuring appropriate responses to societal challenges.

ICGEB:

- performs cutting-edge scientific research, advanced education and training supported by long- and short-term fellowships for PhD students and postdocs.
- organises international meetings, courses and workshops.
- awards competitive research grants for scientists in Member States.
- undertakes technology transfer to industry for the production of biotherapeutics and diagnostics.
- provides scientific and advisory services.
- produces and distributes free digital learning resources.



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