

Information materials on activities and partnerships

I. Introduction

Established by UNESCO as one of its International Science Programmes (ISP) with a specified mandate, strategy, content, and expected results, the International Basic Sciences Programme (IBSP) is providing an overarching platform to fulfil UNESCO's unique mandate in the basic sciences and Science, Technology, Engineering and Mathematics (STEM) education within the United Nations system. Based on this mandate and the Organization's long-standing fruitful activity in the basic sciences and science education, IBSP offers to Member States its expertise as a science capacity lever for scientific innovation and sustainable development.

The basic sciences and STEM education activities of the Organization focus principally on graduate, post-graduate, and high-school teachers, and in promoting research in mathematics, physics, chemistry, the life sciences, including biotechnology, and the human genome project. The International Basic Sciences Programme (IBSP) – the UNESCO's main tool for triggering scientific innovation and harnessing international cooperation for human and institutional capacity building in the basic sciences and science education – aims to advance, transfer, share and disseminate scientific knowledge, and to transform this basic scientific know-how into useful applications for today's multiple sustainable development challenges.

The sustainability challenges of our time require younger and future generations to be scientifically empowered to respond to the nowadays changing world. Indeed, most of today and future employment opportunities, especially for young men and women, are in sectors which require STEM education at the appropriate levels. In this context, UNESCO is designing an ambitious science, technology, engineering and mathematics (STEM) education initiative, *inter alia*, by relying on the Scientific Board of IBSP as a platform for consultation, synergy development and leverage of funding from within the network of UN and other international organizations active in STEM. This STEM initiative could focus on women in sciences, through gender-responsive STEM teachers' trainings to improve the quality of formal curricula, informal education; and also could promote Open access in science.

The IBSP fosters scientific networking and excellence in science through North-South and South-South cooperation. It also creates and strengthens science networks, centres of excellence, and provides scientific expertise for, and advice to, policy- and decision-makers on opportunities offered in science. IBSP also helps in establishing science advocacy mechanisms, such as the International Years, and platforms for scientific collaborations, through category 2 centres and UNESCO Chairs selected on the proposal of Member States, based on the strength of their specialization in one of UNESCO's fields of competence.

Global science initiatives, in general, provide valuable and unique contributions to the implementation of UNESCO's strategic programme objectives for the benefits of Member States, in light of the 2030 Agenda for Sustainable Development that put a new emphasis on the role of STI for sustainable development.

II. The life sciences

IBSP develops several activities in the life sciences, including the establishment of category 2 Centres. One of the last-born, is the Centre located within the University of Nigeria in Nsukka that focus on research and training in tropical diseases and food security. The UNESCO-IBSP/IBRO partnership for capacity building in science has been established through the development of the African Neuroscience Network called for the African scientific community. Health priorities ranging from major diseases (HIV, neuroAIDS, cerebral malaria, neurodegenerative diseases) to neglected diseases (e.g. African trypanosomiasis or sleeping sickness) take a central position in motivating the Network's interdisciplinary actions at the crossroad of neuroscience, molecular biology, biochemistry, biotechnology, genomics and genetics, physics and engineering (imaging techniques) and social sciences (mind and behaviour). Among recent scientific activities organized were, for example, schools, training courses, or workshops. This year's UNESCO-Equatorial Guinea International Prize for Research in the Life Sciences issued its call for applications. The Prize aims at contributing to the stimulation of quality research in the developing world. The Carlos J. Finlay UNESCO Prize for Microbiology acknowledges the importance of microbiology for human health and development. This Prize was established by the Government of Cuba and UNESCO in honour of one of the most important microbiologists in history: Carlos J. Finlay (Camagüey, 3 December 1833 – La Havana, 20 August 1915).

II.1 *The Human Variome Project (HVP)*

The Human Variome Project (HVP) aims to advance in the understanding of the genetic basis of diseases by pooling data on genetic variants from around the world, bringing together information on sequence variation and clinical features in diverse populations. Better understanding of genetic variation in these genes has the potential to improve scientific research, prevention and diagnoses of disease. This will provide a model for management of variation across the human genome. The Global Variome is the international non-governmental consortium (enjoying official relations with UNESCO) of scientists and health-care professionals working together to implement the project across the world. HVP is structured in Country Nodes, national entities that act as a national focal point for genomic data-sharing activities and has a specific role in connecting all the laboratories in a country that provide genetic testing services. Among its goals are the completion of high-quality gene- and disease-specific databases such as:

- BRCA Challenge (with Global Alliance for Genomics and Health) aims to promote the responsible collection, curation, sharing and use of variation data derived from genomic and genetic sequencing related to breast cancer.
- Global Globin 2020 Challenge seeks to apply recent developments in human genomics involving the systematic collection and sharing of variation data to fighting haemoglobinopathies (notably thalassaemias and sickle cell disease) in low- and middle-income countries.

II.2 *The UNESCO-Merck Cooperation*

UNESCO established a partnership with the pharmaceutical company Merck with the objective to improving the cooperation between African public research institutes and the global pharmaceutical industry. Two Summits with Ministerial Panels were organised so far: The UNESCO-MERCK Africa Research Summit in 2015 in Geneva and 2016 in Addis Ababa sponsored over 200 African researchers, representing over 30 countries in Africa, with 60% of the attendees being women, some of whom were awarded fellowships.

II.3 Libyan Funds-in-Trust projects in macromolecular chemistry and biotechnology

The Project “Enhancing Capacity of the Biotechnology Center (BTRC)” was re-initialized in October 2014 following due consultation process. Whereas the first phase of collaboration from 2000 until 2011 focused mainly on the procurement of equipment and improving the infrastructure, the new phase emphasizes the human capacity development in line with the needs of the Centre and national needs. In 2014-2016, project implementation focused on two activities: the Establishment of an International Scientific Advisory Board (ISAB) and a Pilot capacity building activity at the University of Bari Aldo Moro, Italy. In December 2015, eleven Libyan students completed a 14-month Masters Course in Biotechnology for Medicinal and Aromatic plants in Bari (Italy). The first meeting of the ISAB took place in Tunis (Tunisia) in August 2016, in the form of a one-day symposium on research activities at BTRC, followed by the official ISAB meeting. More training activities will be planned in 2017-2018, including long-term placements and short-term training activities. The new phase of the project “Enhancing capacities of the Biotechnology Research Center (BTRC)” is in its initial stages and will focus first on the establishment of an International Scientific Advisory Board (ISAB), who with national partners will assess the scientific outputs of the research centre and draw up a list of priorities in terms of research and training. After the first meeting of the ISAB, training activities will be implemented for the benefit of the BTRC’s staff and in keeping with national needs, mainly in two forms: long term training activities such as: placements in high-quality degree programmes abroad and short terms training activities such as workshops, conferences, seminars, courses and scientific visits. A pilot training activity for ten selected students, namely a 12-month Master level course in the field of biotechnology applications for medicinal and aromatic plants, is currently implemented at the University of Bari Aldo Moro in Italy.

III. Chemistry

The advanced research training of scientists, especially young scientists, as well as university and pre-university teaching staff in chemistry, mathematics and physical sciences is pursued in strong collaboration with international specialized institutions. Special attention is given here to water chemistry, trace elements in water, green chemistry and courses on membrane electrochemistry. In order to promote quality chemistry education worldwide, UNESCO and its partner, mainly the International Union for Pure and Applied Chemistry (IUPAC), is willing to strengthen its action in this domain by increasing the public appreciation and understanding of chemistry, stirring the interest of young people, and generating enthusiasm for the creative future of chemistry. The Trace Element Institute for UNESCO, an international centre for trace element research established under the auspices of UNESCO is also an important part of our programme

III.1 The PhosAgro/UNESCO/IUPAC Partnership in Green Chemistry for Life

The IBSP extrabudgetary PhosAgro/UNESCO/IUPAC Partnership in Green Chemistry for Life was created thanks to an agreement and partnership between UNESCO, IUPAC

and the Russian agricultural fertilizer producer “PhosAgro”. The programme, which had its three first editions in 2014, 2015 and 2016, aims at generating and applying new scientific knowledge in green chemistry through the promotion of the activity in this area among young scientists. It also aims at reinforcing green chemistry research in the participating institutes and cooperation between them, and at increasing awareness of policy- and decision-makers in governments, science and industry, and the public at large, of the opportunities offered by advances in green chemistry. Over 120 applications from all over the world were received for the first rounds of applications for the PhosAgro/UNESCO/IUPAC research grants. A total of 18 awards, six per call, each to the amount of US \$30,000, has so far been awarded to young scientists from all continents.

III.2 UNESCO-Libya *Education and Training in Macromolecular Chemistry*

Since 2000, IBSP and the Government of Libya have been collaborating in the development of the activity of an Education and Training Center for Macromolecular Chemistry and Technology after its establishment in Tripoli. The Project “Education and Training in Macromolecular Chemistry” was implemented from February 2000 until December 2016. UNESCO provided services aimed at the establishment of the Centre for Macromolecular Chemistry and Technology (CMCT). Project implementation focused on two areas: Equipment Acquisition and Maintenance Programme and implementation of training activities in the field of polymer chemistry, especially one training workshop on the mechanical properties of polymers organized in Marrakesh (Morocco).

IV. Physics and Mathematical Sciences

The Mathematics and Physics Programme within IBSP encompasses, *inter alia*, the travelling “Experiencing Mathematics” activity, which is a dynamic and hands-on educational tool based on active learning methodology. Pupils experience mathematics in a funny and challenging manner with the objective of demystifying this discipline. The exhibition that has already travelled to over 100 cities and attracted over 1.5 million visitors is also accessible on-line. The Mathematics of Planet Earth (MPE), launched in 2013 at the initiative of Prof Christiane Rousseau and supported by the International Mathematical Union (IMU) together with several organizations, encourages Mathematics research applications on a range of topics related to the planet Earth including environmental issues such as geophysical processes, weather, oceans and climate change; and human-related processes such as finance, agriculture, transportation; etc. Another activity called by the Member States and the scientific community is the UNESCO’s ALOP Programme supported by SPIE, which enables physics teachers to develop professionally and pass on their skills to their students. The ALOP workshops have trained over 1,700 teachers from 55 developing countries in Africa, Asia and Latin America and the Caribbean. UNESCO’s IBSP and CERN also work together on capacity-building projects in the Basic Sciences, including the setting up, particularly in Africa and the Arab States, of CERN-UNESCO Digital trainings promoting “Open Access” to digital information.

IV.1. *The Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME)*

The SESAME, located in Allan, Jordan is an intergovernmental centre established under the auspices of UNESCO. It will become operational this year with the official opening ceremony to be held in Jordan on 16 May 2017. SESAME is a “third-generation”

synchrotron light source in the making, to be used for research and development in the Middle East and neighbouring countries in physics, chemistry, biology, materials science, nanotechnology, healthcare, environmental research, archaeology, cultural heritage and other areas related to high technology and industry. SESAME is also an excellent example of an active “science diplomacy”, and “science for peace” initiative, being successfully established in the Middle East. Among the members are Cyprus, Iran (Islamic Republic of), Israel, the Palestinian Authority and Turkey. IBSP is closely involved in developing SESAME, widening participation in it, fostering support for it and promoting its users’ training programme.

IV.2 Follow-up of the International Year of Crystallography 2014 (IYCr2014)

Even though crystallography underpins all the sciences today, it remains relatively unknown to the general public. The main aim of the Year was to promote education and public awareness through the OpenLabs Programme – a travelling training programme using a state-of-the-art diffractometer, the Crystal Growth Competition and Regional Summit Meetings. The OpenLabs programme is still active with recent workshop in Senegal and Albania. Some 35 OpenLabs in more than 25 countries have already been organized worldwide, allowing more than 1,000 scientists to benefit from top-class training in crystallography. The first Pan African Conference in Crystallography gathering more than 400 participants was organized in October 2016 at Dschang, Cameroon, triggering and creating a platform for discussion on the future of crystallography in African in the context of a to be established African Crystallographic Association. An upcoming main challenge for the International Union of Crystallography (IUCr) is the IUCr Congress in Hyderabad, India, in August 2017.

IV.3 The UNESCO/CERN Collaboration

CERN and UNESCO recently have celebrated their respective anniversaries, CERN its 60th anniversary, and UNESCO its 70th. As CERN was created under UNESCO auspices in 1954, this prompted the holding of several joint events, conferences and workshops to celebrate the history, common vision, successes, and planning for the future. IBSP was instrumental in all these activities, organizing a CERN day at UNESCO on the occasion of the discovery of Higgs boson with the Large Hadron Collider by CERN, co-organizing the CERN anniversary at UNESCO Headquarters, the “Science for Peace” workshop in Geneva, a joint session with CERN on “Science for Peace” during the 2015 World Science Forum in Budapest, etc. At the same time, IBSP-CERN collaboration for training teachers from developing countries in modern aspects of physics should be revitalized, as well as collaboration for the digital training schools. The IBSP-CERN collaboration also has been reflected in the framework of the International Year of Light 2015. IBSP-CERN-SESAME collaboration has also continued, with CERN actively participating in all SESAME Council meetings during the current biennium.

IV.4. The International Day of Light

The International Year of Light and Light-based Technologies 2015 (IYL2015) was a global success with an estimated 13,168 activities in 147 different countries, 18000 mentions in the world’s media from 120 countries. The audience reached by the International Year of Light is estimated to be over 100 million. Under the leadership of UNESCO, the IYL2015 brought together hundreds of national and international partners to implement a wide range of worldwide activities including: awareness-raising, capacity-building, education and outreach. Building on the success of the Year, UNESCO and its

partners decided to follow it up by the establishment of an International Day of Light which will provide an annual focal point for the continued appreciation of the central role that light plays in the lives of the citizens of the world in areas of science, culture and art, education, sustainable development, and in fields as diverse as medicine, communications and energy. In addition, this Day should build many new bridges between science and culture, and forged new links between decision makers, industry leaders, scientists, non-governmental organizations and the public at large. An International Day of Light will provide an enduring follow-up of the achievements of the International Year of Light by raising the profile of science and technology, and its application towards stimulating education, improving the quality of life worldwide, and achieving the Sustainable Development Goals.

V. Science Education

The steady decline of enrolment of young people in science is cause for concern. The UNESCO Science Education programme aims at updating curricula, offering hands-on workshops, providing kits and guidebooks free of charge, and training teachers and students alike. It also triggers interest in science through competitions, science fairs, etc. Microscience kits are distributed through teaching workshops as part of the Global Microscience Project. This is an international, cost-effective, environmentally-friendly project to develop science education and scientific thinking through practical experimentation at the primary and secondary school levels. Those portable mini-laboratories with proposed physics, chemistry and biology experiments have, so far, been distributed in over 80 countries. Launched in 2013, the UNESCO's partnership with the company INTEL promotes Science Technology Engineering and Mathematics (STEM) in Africa by building capacities and developing learning materials, and working with the Governments of Kenya and Lesotho, to develop gender-sensitive policy frameworks to increase the enrolment and participation of girls and women in STEM education. UNESCO supports the INTEL International Science Fair – the world's largest international pre-college science fair for 1500 high school students from about 70 countries to showcase their independent research.

Science, Technology, Engineering and Mathematics (STEM) is an engine of development and is an important key to innovation. In this age of digital interconnectedness, efforts need to be focused to prepare students at all levels to be global citizens and contribute to achieving the new sustainable development objectives of the UN Agenda 2030 for Sustainable Development. STEM education is about our ability to craft inclusive and sustainable solutions to challenges, such as climate change, water, energy shortages, food and health threats. Fundamentally, it is also about the knowledge-based societies we want to build and live in.

More recently, the UNESCO Member States requested, through the oral report of the Chairperson of the Natural Sciences Commission during the 38th General Conference (document 38 C/INF.22), that priority efforts and actions be made to support STEM education, as well as technical and vocational education and training (TVET), especially in developing countries as this would be in line with the SDG 4 and 9. That is why UNESCO is willing to team up and create a new partnership in view of raising the flag and promoting a Global STEM initiative in every corners of the world, especially in developing countries. We need to support countries at all levels, to integrate STEM education into development frameworks and to support curriculum and teacher's development. Particular efforts are to be made also to attract girls and boys into STEM, and bolster the institutional capacities, including in data and indicators

collection and assessment, and in analytical policy studies on STEM. The initiative also intends to harmonize and coordinate action across UNESCO and its partners towards STEM education issues. In addition to creating a platform of discussion and exchange towards best practices, curriculum and policy settings, and capacity development of educators on STEM, the initiative on STEM education will create a reinforced synergy in-house and among the UN family avoiding redundancies in our efforts to achieve the objectives set by the SDGs 4 and 9 (in terms of fostering innovation) and meeting the requirements of Member States.

V.1 The Microscience Programme

Science education in the context of “the Microscience Programme” is a longstanding project stemming from IBSP collaboration with IUPAC, the RADMASTE Centre at the University of the Witwatersrand in Johannesburg (South Africa) and Somerset Educational (South Africa). It is a hands-on science education project that gives primary- and secondary-school teachers and students, as well as university students, the opportunity to conduct practical work in physics, chemistry and biology, using kits that come with booklets describing scientific experiments. These kits are veritable mini-laboratories, cost effective and safe, as trainees never need to use more than a couple of drops of chemicals for experimentation. The active learning pedagogy underpins the Microscience programme inducing a shift from teacher- to student-centered inquiry-based learning. The project also serves as an advocacy tool among policy-makers to improve science curricula by inclusion of hands-on experimentation for a better understanding of science, and to increase the interest of young people in science careers. The “microscience project” became very popular among UNESCO Member States, with several microscience workshops being organized per year, co-financed by the hosting Member State. The most recent workshops were organized in Comoros Islands (2015), Cabo Verde (2015), Liberia (2016), Zambia (2016) and Gabon (2016). Further workshops are planned in Africa, in particular in Portuguese-speaking countries in Africa (PALOP). The IBSP is designing with ECMDC a comprehensive microscience programme in schools.

V.2 The World Library of Science (WLoS)

A UNESCO – Nature Publishing Group – Hoffmann-La Roche initiative, the WLoS is a free online science resource for a global community of users, hosted by Nature Education. It contains hundreds of peer-reviewed articles that use text, pictures, illustrations and videos to make scientific concepts easy to be understood by youngsters. The online library started with contents in Genetics and Cell Biology while plans to extend the topics covered are being devised.

V.3 Girls and Science: A training module – UNESCO publication

The overall aim of this module is to help reduce gender disparities in the field of science and technology in Africa, as well as to provide women with the possibility of embarking upon science careers in the quest of self-dependence and poverty reduction. Specific objectives include:

- Promoting a positive image of women in scientific and technological careers;
- Sensitizing parents, teachers, educators, school administrative staff, curriculum developers and trainers to counter gender stereotypes with regard to science careers;

- Improving access of girls to scientific and technological education by providing clear ideas of career opportunities;
- Providing teachers with the necessary career guidance tools to meet the needs of female learners seeking careers in science and technology.

The counselling and guidance materials cover science education, depicting the overall picture of women in science including beliefs, attitudes, cultural and societal pressures, together with examples of famous female scientists. They also provide the necessary career guidance tools as well as ways to reduce the under-representation and under-achievement of girls in science and technology subjects and to motivate girls to pursue science and technology education and take up related careers.

V.4 PERFORM (www.perform-research.eu)

PERFORM is a European Commission- funded project aiming to investigate the effects of the use of innovative science education methods, based on performing arts, in fostering young peoples' motivations and engagement with STEM in selected secondary schools in France, Spain and the United Kingdom. PERFORM project looks to move beyond merely increasing scientific and technological knowledge to developing a reflective knowing of science in which young people can consider its purposes, values, and how it becomes reality. Learning science involves restructuring of perception and through this young people might come into new relationships with the subject, and perhaps themselves, in establishing their identity with the subject. To these ends scientific researchers, performers and young people are working together in schools for developing performance- based activities. It is hoped that the collaboration will increase young people engagement with science, its values and the processes of research. UNESCO's role in PERFORM is to promote the sustainability of the project and embed policy linkages between PERFORM and EU science education policy and decision-makers. In addition, UNESCO is also in charge of ensuring the long-term impact and relevance of the PERFORM findings, methodologies and outcomes across Europe and beyond.

VI. Campus Africa

Campus AFRICA is a cooperative project aiming to promote science and scientific development by consolidating scientific, technical, social, cultural, gender-balanced leaderships among younger generations. The project represents a forum for reflection, scientific development and proactive action with regard to the African continent and the tri-continental Atlantic character of the Canary Islands. It is organized by UNESCO, the University of La Laguna, the Canary Islands Foundation for the Control of Tropical Diseases (FUNCCT), the Spanish Sustainable Development Solutions Network (REDS), and the Foundation Women for Africa.