PROSPECTUS

An International Year of Light and Light-based Technologies

2015

Education and Outreach in Light for Society and the World


International Year of Light Consortium
July 2014

www.light2015.org
Young and old around the world are inspired and united by the beauty of light in Nature. The rainbow is a striking illustration of both the scientific and cultural aspects of light.
Executive Summary

The International Year of Light is a cross-disciplinary educational and outreach project with more than 100 partners from over 85 countries, accompanied by the UNESCO International Basic Sciences Programme (IBSP). A resolution welcoming and endorsing an International Year of Light in 2015 was adopted by the UNESCO Executive Board at its 190th session which took place at the UNESCO Headquarters in Paris from 3-18 October, 2012 and by the UNESCO General Conference at its 37th session, on 19 November, 2013. The 68th Session of the United Nations General Assembly adopted the International Year of Light on 20 December 2013.

An International Year of Light will contribute to achieving the aims of the UNESCO 36 C/5 Major Programme II in Natural Sciences, especially the biennial sectoral priorities Strengthening science, technology and innovation (STI) systems and policies for sustainable development, poverty eradication, and a culture of peace and non-violence, as well as mobilizing science for the sustainable use of natural resources, renewable energy and energy efficiency, and for natural disaster reduction and mitigation. In addition, the areas where an International Year of Light will bring especially strong focus are: (i) the advancement of science and technology for sustainable development; (ii) the promotion of UNESCO’s Priorities for Africa with focus on Education for All and Gender Equality; and (iii) the harnessing of international cooperation for science and technology capacity-building.

Light science is one of the most accessible themes to promote cross-disciplinary education. Light has been a major factor in the evolution of humankind and our biosphere. People worldwide benefit from the advances in the fields of light science and applications, which help in achieving and in going beyond the United Nations Millennium Development Goals.

Light-based technology, often referred to as photonics, describes a range of applications aimed at directly raising the quality of life worldwide by reducing child mortality, improving maternal health, and combating disease. The field of Green Photonics studies ways to apply light technology to generate energy and yield environmentally sustainable outputs. Light-based technology is a major economic driver with potential to revolutionize the 21st century as electronics did in the 20th century.

The Proclamation of an International Year of Light by the United Nations will ensure the importance of light and its potential applications are appreciated by all.
Mission

The International Year of Light is a global initiative that will highlight to the citizens of the world the importance of light and optical technologies in their lives, for their futures, and for the development of society.

The International Year of Light will consist of coordinated activities on national, regional and international levels.

Activities will be planned so that people of all ages and all backgrounds from all countries enjoy and appreciate the central role of light in science and culture, and as a cross-cutting scientific discipline that can advance sustainable development.

Background

The International Year of Light project includes over 100 partners from over 85 countries, including scientific societies, museums, universities and other organizations. The partnership has been working since 2010 to prepare the groundwork for a coordinated series of activities throughout the world during 2015.

The project has received endorsement from the International Council for Science (ICSU) and unions representing many different branches of science: IUPAP (Pure and Applied Physics); IUPAB (Pure and Applied Biophysics), IUTAM (Theoretical and Applied Mechanics), IUHPS (History and Philosophy of Science); IAU (Astronomy); ISPRS (Photogrammetry and Remote Sensing); URSI (Radio Science). The partnership also includes the International Center for Theoretical Physics (ICTP) and SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East).

The society partners have extensive and successful track records in international outreach and joint ventures such as the 2005 International Year of Physics and long-term educational programmes in both developed and developing countries. The Partnership possesses the resources and experience to ensure tremendous impact and success for an International Year of Light.

The project is accompanied by the UNESCO International Basic Sciences Programme (IBSP).
The Resolution

A resolution welcoming and endorsing an International Year of Light in 2015 was adopted by the UNESCO Executive Board at its 190th session which took place at the UNESCO HQ in Paris from the 3rd - 18th October 2012. The resolution was placed before the Executive Board by Ghana, Mexico, and the Russian Federation (Board Members) and New Zealand (UNESCO Member State). UNESCO delegates from Ghana and Mexico introduced the proposal to the Executive Board. The resolution was adopted by the Executive Board joined by co-signatories from a further 28 Board Members: Angola, Bangladesh, Brazil, Burkina Faso, China, Congo, Cuba, Djibouti, Ecuador, Ethiopia, Gabon, Gambia, Kenya, Indonesia, Italy, Malawi, Nigeria, Peru, the Republic of Korea, Saudi Arabia, Spain, Thailand, Tunisia, the United Arab Emirates, the United States of America, Venezuela, and Zimbabwe. Other Member States of UNESCO who declared support for the initiative were Hungary, Serbia and South Africa.

The UNESCO Executive Board resolution was endorsed by the UNESCO General Conference at its 37th session on the 19th November, 2013. In parallel, a resolution was submitted to the United Nations Second Committee on 6 November 2013 by the nation of Mexico, with delegates from both Mexico and New Zealand speaking in support. The resolution was adopted with co-sponsorship from 35 countries: Argentina, Australia, Azerbaijan, Bosnia and Herzegovina, Chile, China, Colombia, Cuba, Dominican Republic, Ecuador, France, Ghana, Guinea, Haiti, Honduras, Israel, Italy, Japan, Mauritius, Mexico, Montenegro, Morocco, Nepal, New Zealand, Nicaragua, Palau, Republic of Korea, Russian Federation, Somalia, Spain, Sri Lanka, Tunisia, Turkey, Ukraine and United States of America.

The resolution A/RES/68/221 proclaiming the IYL 2015 was adopted on 20 December 2013 during a plenary meeting of the 68th Session of the UN General Assembly.
Motivation

Light plays a central role in human activities. On the most fundamental level through photosynthesis, light is necessary to the existence of life itself, and the many applications of light have revolutionized society through medicine, communications, entertainment and culture. Industries based on light are major economic drivers, and light-based technologies directly respond to the needs of humankind by providing access to information, promoting sustainable development, and increasing societal health and well-being. As light becomes the key cross-cutting discipline of science and engineering in the 21st century, it is essential that the brightest young minds continue to be attracted into careers in this field.

All fields of science are based on the theories of light and its interaction with matter, and light is one of the main messengers in our understanding of the Universe and the subatomic world. The history of the study of light spans centuries, and has involved virtually all the major figures of science. And it was the 20th century that saw the birth of the modern theory of light, the invention and application of lasers, the widespread deployment of photonic devices to improve society, and the full appreciation of the fundamental place that light occupies in the fabric of space and time. The spectrum of light from X-rays to infrared lasers provides technologies that underpin our lives, optical technologies have revolutionized medical diagnostics and treatment, and light and photonics are poised to become the key enabling technologies of the future.

Light is the means by which human beings see themselves, each other, and their place in the Universe. Light is an essential part of culture and art and is a unifying symbol for the world. An International Year of Light is the ideal instrument to ensure the necessary increased worldwide awareness of the central role of light in the present and in the future of us all.
Goals

An International Year of Light will coordinate international and national activities in order to achieve the following goals.

- Improve the public understanding of how light and light-based technologies touch the daily lives of everybody, and are central to the future development of the global society.

- Build worldwide educational capacity through activities targeted on science for young people, addressing issues of gender balance, and focusing especially on developing countries and emerging economies.

- Enhance international cooperation by acting as a central information resource for activities coordinated by learned societies, educational establishments and industry.

- Focus on particular discoveries in the nineteenth and twentieth centuries that have shown the fundamental centrality of light in science.

- Highlight the importance of research both into the fundamental science of light and its applications, and promote careers in science in these fields.

- Promote the importance of lighting technology in sustainable development, and for improving quality of life in the developing world.

- Highlight and explain the intimate link between light and art and culture, enhancing the role of optical technology to preserve cultural heritage.

- Maintain these goals and achievements in the future beyond the International Year of Light.

An International Year of Light will contribute significantly to fulfilling the missions of UNESCO to the building of peace, the alleviation of poverty, to sustainable development and intercultural dialogue through education, science, culture, and communication.
**Themes & Activities**

**Context**

Light is a subject that cuts across science and culture.

- Through biology and photosynthesis, light is at the very origin of life. The science and technology of light are essential for the future development of humankind, and in the search of solutions to **solve global problems in sustainability and healthcare through international cooperation**.

- Through studies in fundamental science ranging from particle physics to cosmology, **light provides a window on the universe**, and our efforts to understand the properties of light have led to revolutions in many different areas of science and engineering.

- **An International Year of Light is not only about science and technology.** Light is the means by which humanity sees itself, and the many ways that light has impacted on society have inspired art, music, literature and philosophy across the centuries.

- **Light is a subject that unifies humanity.** All nations and all peoples see the same Sun rise and fall on the horizon, and all cultures throughout history have expressed the same wonder at the natural beauty of light seen in effects such as the rainbow.

An International Year of Light will allow the universality of light and the variety of its applications to be appreciated via many and varied themes covering broad areas of interest, supported by cross-cutting themes addressing essential issues to be included in all activities. Actions will be implemented on national, regional and international levels. The main structure of these activities is illustrated below.
Thematic coverage

The activities of an International Year of Light will be structured around four broad thematic subject areas and important cross-cutting actions addressing central elements of sustainability, education and history.

Science of Light

Studying the fundamental scientific properties of light has impacted widely on all fields of science, technology and engineering. From early attempts to understand the motion of stars and planets to the appreciation of the importance of light in photosynthesis, efforts to understand the nature and the characteristics of light have revolutionized nearly every field of science. Light from the Big Bang provides us with a vision of the origin of the Universe. The spectrum of light from X-rays to infrared lasers provides technologies that underpin our lives, and the interaction of light with the human body provides valuable techniques for diagnosis, imaging and treatment in medicine. Advanced research in areas such as nanophotonics, quantum optics and ultrafast science are inspiring new fundamental discoveries and opening new scientific frontiers.

This theme will highlight the fundamental scientific properties of light and why it is essential to continue research in this field for the future.

Light Technology

The science of light is applied in the technological field known as photonics, and this theme addresses the important ways that photonic devices impact on areas such as medicine, communications and energy.

Light plays a crucial role in modern life and in shrinking the modern world that is often unknown and unappreciated. Light pulses and advanced optical fibre cables form the backbone of the global internet, and satellite telephones and wireless technologies allow even the most remote areas of the world to have access to communications, information and even advanced medical care. Light Technology is essential to improve society’s energy independence through devices that efficiently convert sunlight to other energy forms, and new forms of low cost green lighting. In a similar way, understanding the Earth’s environment increasingly relies on optical and photonic techniques for sensing and measurement.

These examples are of course state-of-the-art feats of engineering. But at the same time, optical technologies that are simple and that have existed for centuries are tremendously important for our daily lives! Corrective eyeglasses for improved vision are familiar to us all, and simple optical instruments such as microscopes form a cornerstone of modern medical diagnostics. This theme will describe light technology and its many applications, and will focus on how optics is placed to be a key driver of innovation in the 21st century.
Light in Nature

The wonder of light and colour is revealed spectacularly in effects such as sunsets, rainbows, halos, and shadows to cite just a few examples of the rich variety of optical phenomena which can be found in nature. This theme will raise awareness of the beauty and accessibility of science through activities that will encourage and support observation of light and colour in the Natural world. No matter where one lives and no matter what one’s age, it is easy and delightful to understand Nature through light: from ice crystals near the artic to mirages in the desert to shadows in the forest to shifting images on water, the wonder and beauty of natural optics is everywhere. And of course, this theme provides a natural place to consider how observing light in nature often means turning off the lights from modern society. Whilst modern lighting provides important and crucial opportunities and advantages in improving quality of life, raising awareness of the issue of light pollution will also be an important feature of this theme.

Overall, in these days where downloading images of nature from the internet has largely replaced direct observation, activities in this theme will encourage outdoor observation in all-weathers and at all-latitudes, aiming to inspire a new generation of scientists to open their eyes.

Light and Culture

Activities in this theme will highlight the myriad ways in which light has influenced and continues to influence human culture. From the early artists and scientists of Antiquity to the development of perspective and the understanding of light and shadow during the Renaissance, to impressionism and modern artistic techniques, this theme will describe how the study of light and art is central to understanding and appreciating our cultural heritage. Describing the continuous links between light and culture throughout history will provide valuable insights into the interactions between science and art and the humanities in general.

In a contemporary context, this theme will also describe ways in which light can be used to improve our appreciation of cultural heritage in ways such as applying optical techniques to image paintings, the use of modern technology in museums to experience culture in an interactive environment, and the use of natural light and low-pollution lighting to illuminate architecture, monuments and public spaces.
Optical technologies give new impetus in many areas of study - from art to archaeology

Light has influenced and continues to influence the visual and performing arts, literature and human thinking. This theme will provide an important bridge between science and culture and will aid in breaking down the boundaries between these fields that are becoming increasingly separated in the modern world.

**Cross-Cutting Themes**

Several important themes of the International Year of Light will cut across, and be central to, all the activities described above.

Ensuring that science and technology are relevant to development and sustainability is essential, and modern optical technologies can play a vital role through low carbon emission solar lighting, and in areas such as agriculture, disease prevention, and water purification.

Light is an inspiring subject in both art and science, and promoting education for young people in these fields is a natural lever towards promoting higher education and encouraging careers in multidisciplinary fields in general. Addressing gender imbalance will be an essential part of this action as well.

A particular aspect of educational activities that can highlight the complex way in which science and society develops internationally is through the history of the science of light; this has involved virtually all the major figures of science over 2000 years and from all continents. Highlighting their often unknown human stories will be an inspiring educational and outreach activity for a new generation.
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The broad scope of an International Year of Light will be explained through an educational website which will collate information about event and activity planning worldwide. Activities of the year are structured around key themes which are described in detail on the website. Please browse the website and get involved!
The year 2015 is a natural candidate for the International Year of Light, commemorating a number of important milestones in the history of the science of light dating back 50, 100, 150, 200 years and even further.

In 1815, Fresnel published his first work introducing the theory of light as a wave and in 1865, Maxwell rigorously described the dynamic electro-magnetic theory of light. In 1915, the theory of General Relativity developed by Einstein showed how light was at the centre of the very structure of space and time. In 1965, Penzias and Wilson discovered the Cosmic Microwave Background, an electromagnetic echo of the very creation of the universe, and fiber optics pioneer Charles Kao developed the low loss optical fibre that enabled internet communications.

These discoveries changed physics profoundly when they were made, and continue to have tremendous impact on science and technology. The wave theory of light and the laws of electrodynamics have led to developments ranging from lasers and DVDs to mobile phones to wireless internet to radio astronomy. The laws of general relativity and the study of the Cosmic Microwave Background have impacted on areas from the design of the global GPS satellite system to fundamental questions concerning the origin of the Universe.

Even more generally, the year 2015 also celebrates 1000 years since the great works on optics by the pioneering scientist Ibn Al-Haytham, and represents 400 years since the invention of the first solar powered technology through the 1615 invention of a prototype solar-driven engine. Highlighting these anniversaries will provide valuable educational and historical perspectives.
Contacts

Steering Committee and Secretariat

John Dudley  
Steering Committee Chair  
International Year of Light and Light-based Technologies 2015  
president@eps.org

Joe Niemela  
Global Coordinator (IYL Secretariat)  
International Year of Light and Light-based Technologies 2015  
light2015@ictp.it

Jean-Paul Ngome Abiaga  
Assistant Programme Specialist  
International Basic Sciences Programme  
UNESCO HQ, Paris  
jj.ngome-abiaga@unesco.org

Partners

The International year of Light project is supported by a large number of partners, and managed by a Steering Committee and Advisory Board that ensures links with other learned societies and organisations. The consortium also includes many regional centres of science and science education, and contains representatives spanning broad areas of science, history of science, technology, art history, cultural heritage and education etc.

Please see www.light2015.org for updated information about our Founding Partners, Patron Sponsors and the large number of Associates and National Committees that will support actions throughout 2015.