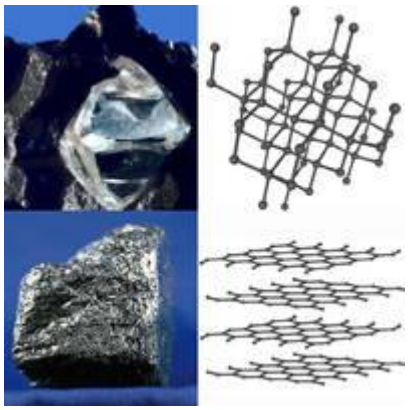
Crystals shape our world



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The crystal structure of graphite (bottom) is very different from that of diamond although both are pure carbon.

Crystals —familiar to all in gemstones, glittering snowflakes or grains of salt— are everywhere in nature. Throughout history, people have been fascinated by their beauty and mystery. Two thousand years ago, the process of crystallizing sugar and salt was already known to the ancient Indian and Chinese civilizations. Since then, the study of crystals' inner structure and properties has known steady progress, giving us our deepest insights into the arrangement of atoms in the solid state and leading to advancements the sciences of solid-state physics, chemistry, biology, medicine and even mathematics, by considering the symmetries behind crystalline and quasicrystalline patterns.

In the early 20th century, it was discovered that X-rays could be used to 'see' the structure of matter in a non-intrusive manner, thus beginning the dawn of modern crystallography —the science that examines the arrangement of atoms in solids. X-ray crystallography has allowed us to study the chemical bonds which draw one atom to another. Crystallographers now apply this knowledge to modify a structure and thus change its properties and behavior. Since this discovery, crystallography has become the very core of structural science, revealing the structure of DNA, allowing us to understand and fabricate computer memories, showing us how proteins are created in cells and helping scientists to design powerful new materials and drugs. Thus crystallography has many applications. It permeates our daily lives and forms the backbone of industries which are increasingly reliant on knowledge generation to develop new products, in widely diverse fields that include agro-food, aeronautics, automobiles, cosmetics and computers as well as the electro-mechanical, pharmaceutical and mining industries.

Image: Wikimedia.
Snowflakes are crystals. Their hexagonal symmetry results from the way in which water molecules are bound to each other.

Although crystallography underpins all of the sciences today, it remains relatively unknown to the general public. That is one of the reasons why the United Nations General Assembly (UNGA) proclaimed 2014 as the International Year of Crystallography (IYCr2014)*, and requested UNESCO to lead and coordinate, with the International Union of Crystallography (IUCr), the planning and implementation of educational and capacity-building activities during the Year.

2014 marks the centennial of the birth of X-ray crystallography, thanks to the work of William Henry, William Lawrence Bragg (father and son) and Max von Laue —the later was awarded the 1914 Nobel Prize in Physics for his discovery of the diffraction of X-rays by crystals.

A century later, the International Year of Crystallography 2014 highlights the continuing importance of crystallography and its role in addressing post-2015 development issues such as food security, safe drinking water, health care, sustainable energy and environmental remediation; as well as commemorating auspicious crystallography accolades. This Year also commemorates the 50th anniversary of another Nobel Prize, awarded to Dorothy Hodgkin for her work on vitamin B12 and penicillin, and is the 400th anniversary of Kepler's observation of the symmetrical form of ice crystals (in 1611), thus beginning the wider study of the role of symmetry in matter.

* At its sixty-sixth session in July 2012

Main objectives

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Crystallography can identify new materials that purify water, such as nanosponges

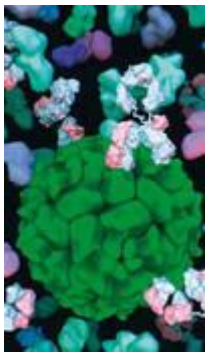
- Increasing public awareness of the science of crystallography and how it underpins most technological developments in our modern society
- Inspiring young people through public exhibitions, conferences and hands-on demonstrations in schools
- Illustrating the universality of science
- Supporting the Africa Initiative on Crystallography and creating similar programmes in Asia and Latin America
- Fostering international collaboration between scientists worldwide, especially North–South contributions
- Promoting education and research in crystallography and its links to other sciences
- Involving the large synchrotron and neutron radiation facilities worldwide in the celebrations of IYCr2014, including the SESAME project set up under UNESCO auspices

Main activities

Phillip Maiwald/Wikipedia.
Lotfollah Mosque in Iran.

- Organizing hands-on Crystallography Open Laboratories
- Encouraging the organization of Crystal Growth competitions worldwide
- Fostering the organization of Crystallography Exhibitions
- Launching an open-access crystallography journal
- Providing all levels of students, from pre-school to university, with crystallography demonstrations at appropriate levels
- Publicizing the contributions that crystallographers make to the global economy by submitting articles to the press and to magazines or developing television and radio programmes
- Sponsoring poster exhibitions highlighting the usefulness and wonders of crystallography
- Organizing problem-solving projects through which students can use their knowledge of crystallography, physics and chemistry
- Publicizing the contributions that crystallography has made to improve lives, particularly recent developments in drug design and material science
- Organizing crystal-growing competitions
- Interacting with governments to underscore the importance of a strong crystallographic education
- Organizing consultations concerning the best ways to save all diffraction data collected in large-scale facilities and crystallography laboratories

Key events



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Antibodies binding to a virus.

- Opening Ceremony of the IYCr204, UNESCO Headquarters, 20-21 January 2014
- Open Laboratories in Crystallography, in Africa, Asia and Latin America, during the Year
- Asian Summit Meeting on Crystallography, Karachi, Pakistan, 28-30 April 2014
- Latin America and Caribbean Summit Meeting on Crystallography, Campina, Brazil, September 2014
- African Summit Meeting on Crystallography, Bloemfontein, South Africa, 15-17 October 2014.