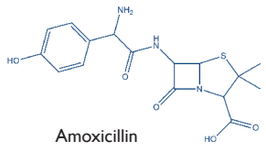
Introduction

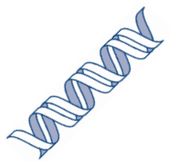
Have you ever seen those little pictures of a molecule of your prescribed medication? …or a drawing of DNA showing two strands winding around each other?



Amoxicillin

Molecules are too small to be seen by normal microscopy.

X-ray crystallography is one of the few techniques that can visualize them and was used to determine the first molecular structures ever known.

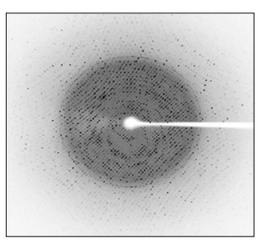


Schematic picture of DNA

X-rays & X-ray Crystallography

How They Work

- X-ray beams are shot through a crystal composed of the material of interest and some of the X-rays diffract (veer off at different angles)
- We calculate how the diffracted X-rays would look, if they could be focused with a lens, to obtain the molecule's structure



This is an X-ray diffraction pattern from a protein crystal. Hundreds of these diffraction patterns are needed to determine a protein structure. The X-ray study can also reveal information about the drugs that bind to the proteins. The protein is chemically bound to a cancer-preventive nutrient.

(Journal reference: Crichlow, Fan, Keeler, Hodsdon, and Lolis, Biochemistry, (2012) vol. 51, pgs. 7506-7514)

Where They Work

- X-rays, CAT scans, and Mammograms: Diagnostic imaging and treatment of diseases
- Insulin, Penicillin, and more: Development of medicine
- Airport Security: Scanning luggage and freight cargo
- DNA studies for Crime Investigation
- Understanding diseases: Sickle cell anemia, thyroid gland diseases, stomach ulcer, phobias, diabetes, hypertension, and more
- Identifying minerals in oil industry

About the International Year of Crystallography

The United Nations declares 2014 as the official International Year of Crystallography. It commemorates not only the centennial of X-ray diffraction, which allowed the detailed study of crystalline material, but also the 400th anniversary of Kepler's observation in 1611 of the symmetrical form of ice crystals, which began the wider study of the role of symmetry in matter.

Learn more at **http://iycr2014.org**

About IUCr

The International Union of Crystallography is a not-for-profit, scientific organization that aims to:

- promote international cooperation in crystallography
- contribute to all aspects of crystallography
- promote international publication of crystallographic research
- facilitate standardization of methods, units, nomenclatures and symbols
- form a focus for the relations of crystallography to other sciences

The IUCr fulfils these objectives by publishing primary research journals and the International Tables for Crystallography series of reference volumes, distributing the quarterly IUCr Newsletter in print to nearly 600 libraries and various crystallographic meetings and electronically to more than 12,000 crystallographers and other interested individuals in 102 countries, maintaining the online World Directory of Crystallographers, and organizing the triennial Congress and General Assembly.

Visit **www.iucr.org** for more information

About ACA

The American Crystallographic Association Inc. is also non-profit, scientific organization of over 2,200 members in more than 60 countries, focused in North and South America. The organization aims to:

- promote interactions among scientists who study the structure of matter at atomic (or near atomic) resolution
- advance experimental and computational aspects of crystallography and diffraction

Visit **www.amercrystalassn.org** for more information

Brochure prepared by S. Narasinga Rao and designed by Vanessa Reitz (vjreitz.prosite.com)

What do New Drug Design, DNA Studies and X-rays have in common?

Crystallography!

- the science devoted to the study of the arrangement of atoms in matter

We're Celebrating!

2014

international year of crystallography

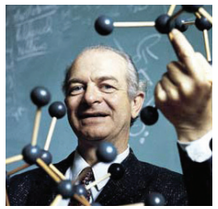
International Union of Crystallography

Highlights of the Many Nobel Prizes Awarded to Crystallographers

See a complete list of winners at **iucr.org/people/nobel-prize**

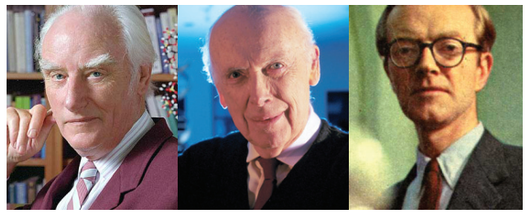
1901

Wilhelm Röntgen
Discovery of X-rays



1954

Linus Pauling
Alpha-helical structure of proteins, nature of chemical bonds

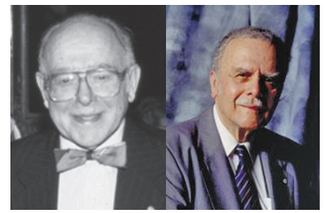


1962

Francis Crick, James Watson & Maurice Wilkins
Created DNA model: double-helical structure for biological information storage

1985

Herbert Hauptman & Jerome Karle
Direct mathematical methods of determining crystallized materials



1994

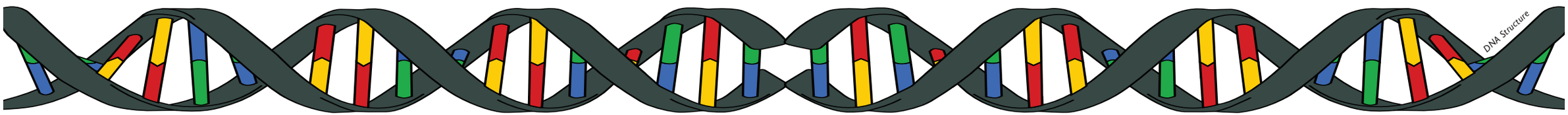
Clifford Shull & Bertram Brockhouse
Electron diffraction and neutron diffraction

2009

Venki Ramakrishnan, Tom Steitz & Ada Yonath
Studies of the structure and function of the ribosome

2011

Dan Shechtman
Discovery of quasicrystals

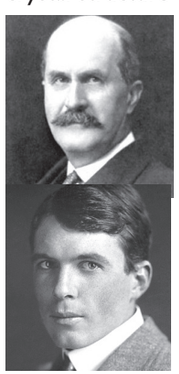


1914

Max von Laue
First demonstrated X-ray diffraction through crystals

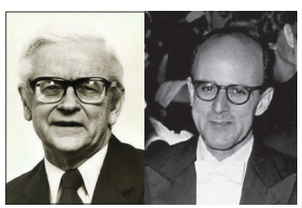
1915

Sir William H. & Sir William L. Bragg
First atomic crystal structure



1962

John Kendrew & Max Perutz
Hemoglobin: Transport protein, which led to the understanding of Sickle Cell Anemia

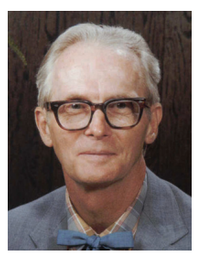


1964

Dorothy Hodgkin
Structures of cholesterol, penicillin, vitamin B12, and insulin

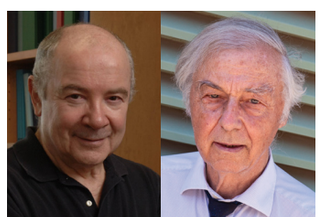
1976

William Lipscomb
The structure of boranes, illuminating problems of chemical bonding



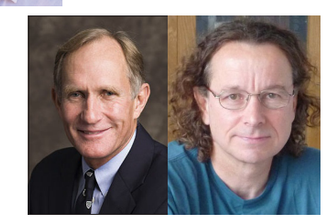
1988

Johann Deisenhofer, Robert Huber & Hartmut Michel
First membrane protein that is essential to photosynthesis



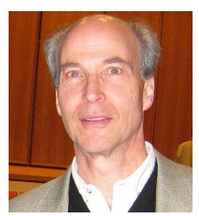
2003

Peter Agre & Roderick MacKinnon
Discoveries concerning channels in cell membranes



2006

Roger Kornberg
Studies of the molecular basis of eukaryotic transcription



2013

Martin Karplus, Michael Levitt & Arieh Warshel
Development of sophisticated computer simulations for complex chemical processes

Additional Important Contributors to Crystallography

Arthur Patterson
The Patterson Function (equation) gives a map of the vectors between atoms

David Harker
Applied Patterson's map to identify planes and sections on different axes in molecular structures