

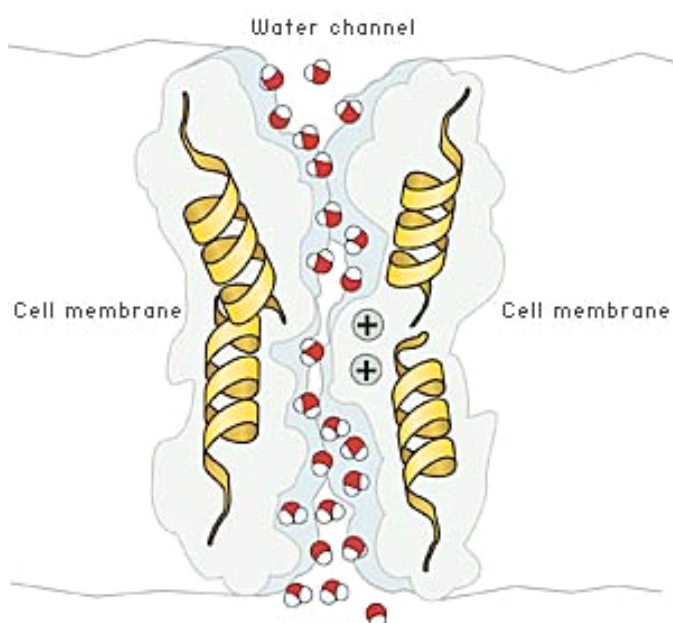
Synchrotron Investigations

5.1 Modelling X-ray diffraction in the classroom

Background

Waves such as water waves, sound waves or electromagnetic waves often bend or pass around objects; this bending is known as diffraction. The degree of diffraction depends on the size of the object, and the wavelength of the wave. When an object is very small, such as an atom or a molecule, very small wavelength waves, such as X-rays, are required to observe diffraction effects. X-ray diffraction 'patterns' can be used to determine the arrangement of atoms and molecules in a material.

One of the most useful features of a synchrotron is that it produces very bright X-rays that have well defined wavelengths. These X-rays are useful for examining the diffraction patterns from various materials.



The 2003 Nobel Prize in chemistry was awarded to Peter Agre and Roderick MacKinnon who used the X-rays from a synchrotron to help determine the structure of 'water channels' in cells. These channels allow water to flow through cell membranes.

Structure of a water channel in a cell membrane

Image courtesy: Australian Synchrotron, State of Victoria

Biophysicists from the University of Western Australia, use X-rays from a synchrotron to determine the amount of iron deposited in living cells that are affected by a condition known as 'iron overload' disease or haemochromatosis.

In this experiment your students will use laser light (instead of X-rays) to determine the structure of a very fine mesh (Experiment 1) and then the width of a fine hair (or wire, or gap in Experiment 2). The principles used are very similar to the methods employed in cutting-edge research at synchrotron facilities around the world.

There is a video available demonstrating a similar experiment as that outlined in this section.

Teachers, please note, for information on the maths relating to this please see section 7.2.

