

SYNCHROTRON INVESTIGATIONS

connecting science and mathematics in schools



The Australian Synchrotron

Image courtesy: Australian Synchrotron, State of Victoria

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Synchrotron Investigations

Introduction

Mathematics and science have developed side-by-side throughout human history. The explosion of scientific knowledge since the Renaissance period (16th century) has been dominated by interaction between new scientific discoveries with mathematical innovations. Many of the great scientists were also good mathematicians, such as Newton, Einstein and Feynman.

Mathematics is essential to many sciences. One important function of mathematics in science is the role it plays in the expression of scientific models. Observing and collecting measurements, as well as hypothesising and predicting, requires mathematical models and extensive use of mathematics.

This project, *Synchrotron Investigations – connecting science and mathematics* aims to create connections between mathematics and science using the context of a synchrotron. The Australian Synchrotron, an exciting, cutting-edge research facility has recently been built and opened in Melbourne, Victoria. This project has been developed by Western Australian science and maths teachers in conjunction with research scientists and educationalists at the University of Western Australia.

Science and mathematics have obvious associations, yet there is usually little connection between science and maths departments in Australian schools. This project aims to provide strategies and resources that will enable teachers to connect mathematics and science easily and effectively. The target audience for this resource is high achieving, year 10 high school students. Most of the material will also be very valuable to senior school physics students.

The complete program is ordered in a logical learning sequence and is designed to allow maths and science teachers to select from the stand-alone modules to design a learning program that they feel confident in presenting and that suits student needs.

We encourage collaboration between maths and science teachers in the creation of a joint program that will provide students with a stimulating cross-curricular learning experience. This collaborative process has been shown to be very beneficial to the quality of education in schools. In the past, the problem with collaborative programs has always been time and resource allocation. We have attempted to address this issue by providing easy to use, clear resources that support and encourage cross-curricular projects. We hope this resource is a catalyst for further and future cooperation between departments.

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Suite of short video clips of Dr Tim St Pierre discussing:

Chapter 1 – Why he chose science as a career

Chapter 2 – His current research on human ‘iron overload’ disease and how he uses the synchrotron to assist him

Chapter 3 – The important connection between maths and science

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b) Segment 1 – What is a synchrotron?

c) Segment 2 – The history of synchrotrons

d) Segment 3 – What are synchrotrons used for?

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Synchrotron Investigations

How to use this resource

This comprehensive resource has been designed to highlight the importance of integrating maths and science in Australian Schools using a synchrotron as a context.

This resource package is made up of four different elements.

These are:

- teacher notes,
- student activities,
- video clips, and
- multimedia resources.

Teacher notes

These notes provide background information for teachers on the area being investigated and on student activities.

Student activities

These sections provide background information, exercises and experiment instructions for students.

Video clips

A suite of three short videos is available for students and teachers to view. They feature Dr Tim St Pierre, a leading scientist at the University of Western Australia. Dr St Pierre is currently undertaking leading-edge research on human 'iron loading' diseases in the field of medical science and biophysics. The videos illustrate: why Dr St Pierre chose a career in science; how and why he uses a synchrotron in his research; and the importance of integrating science and mathematics.

Multimedia resources

These resources are supplied to add a unique element to students' learning. In this resource there are four interactive learning objects and one PowerPoint presentation.

The PowerPoint presentation is available as an introductory tool for students. It has been designed to offer background information on the Australian Synchrotron. Student activity and teacher notes complement this.

The digital interactive learning objects allow for student exploration and experimentation. The four digital learning objects are imbedded in lessons and are as follows:

- The *Electromagnetic spectrum explorer* (section 3.1) – created to allow students to investigate the EM spectrum. Data collected from this explorer is used in student activities.
- *Light intensity explorer* (section 9.4) – has been created to introduce students to the inverse square law. This learning object can be used by students for background information or as a replacement activity to the light intensity experiment.
- *Standing waves explorer* (section 10.1) – this explorer allows students to experiment with wavelength and frequency in order to gain an understanding of waves, in particular standing waves.
- *Polygonal paths explorer* (section 11.6) – this object illustrates how polygons can be used to approximate pi. This illustrates the idea of limits and a historical view on the acceptance of pi approximation.

Other information

Throughout the resource different units of measurement are used (m s^{-1} , km hr^{-1}). This is with the intention of giving students experience in unit conversion.

In some activities (especially those in Section 12), Physics Data Sheets may be required.

The resources are available in two formats. As PDF documents or as Word documents. The Word documents are available so that teachers can make any necessary changes to allow for tailoring for the specific needs of their classes.

Contacts

If you have any problems with these resources or the webpage, the following contacts should be able to assist you.

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