

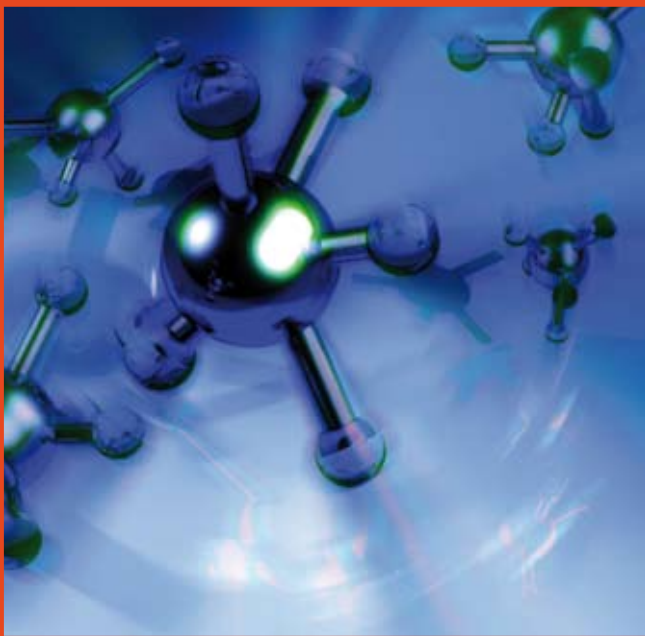
advanced applied science

GCE A2 UNITS

for AQA and OCR

4
science

4science
.org.uk



advanced applied science

GCE AS UNITS

Published by

4science
6 The Courtyard
Dean's Farm
Stratford sub Castle
Salisbury SP1 3YP

www.4science.org.uk

© 2008 The Nuffield Foundation

All rights reserved. Sheets from this disc may only be reproduced for use in connection with teaching within the establishment for which they were originally purchased. The disc may only be used on one computer or internal network within the establishment for which it was originally purchased. This licence does not allow users to disturb the integrity of materials in any way. Cutting or pasting parts of these documents whether physically or electronically is an infringement of copyright.

Getting started:

Insert the disc in the CD ROM drive. The disc should autorun on a PC. If not, click on Start, select Run and type D:/autorun.hta (where D is your CD ROM drive letter).

System requirements:

PC with Windows NT/2000/XP. Javascript- enabled web browser. Minimum screen resolution 800 x 600 (at lower resolution some scrolling may be necessary). Adobe Acrobat Reader to view PDF files (follow link on disc for free download if not already installed). MS Word and MS Excel for other files.

Disclaimer:

This disc has been thoroughly tested and scanned at all stages of production. Responsibility cannot be accepted for any external websites, disruption, damage and/or loss of your data or computer system that may occur while using this CD.

About the resource

This resource provides a variety of activities which are useful for the delivery and assessment of AQA or OCR GCE A2 Applied Science.

You may also find it helpful for other courses, particularly to support *how science works* aspects of the new A levels.

Each activity includes:

- *Activity brief*, which describes the tasks to be carried out.
- *The science at work*, which sets the tasks in a vocational context.
- A variety of work sheets and information sheets, which may be downloaded in PDF or Word format and printed for student use.
- *Teacher notes*, which contain technical notes on the equipment and materials required, hints and suggested teaching strategies and references to other supporting resources.

The resource does not provide full coverage of all units. However, it does contain much new material and new approaches.

Using the CD ROM

Use the left-hand menu to navigate.

In the activity lists, click on Word or PDF to obtain the activity in your preferred format.

Run your cursor over the title for a brief synopsis of each activity.

The *Support materials* section has links to other files, such as Excel spreadsheets, which are useful for some activities.

Note: This booklet lists all activities in alphabetical order. The disc splits them into OCR and AQA, and sorts them by unit.



Cells and batteries

Supports: OCR Unit 12

Students explore issues concerning different types of cells and batteries.

STUDY SHEET *Commercial cells and batteries.* How cells and batteries differ and how to choose, maintain and recycle them.

STUDY SHEET *The language of cells and batteries.* Compiling a glossary of the technical terms used when dealing with cells and batteries.

PRACTICAL SHEET *Making and testing electrochemical cells.* Investigating factors that may affect the potential differences of cells.

PRACTICAL SHEET *Emf and internal resistance.* Experimental determination of emf and internal resistance.

STUDY SHEET *Standard electrode potentials.* Calculating theoretical values for cell emf and comparing calculated and measured values.

Comparing thermometers or blood pressure monitors

Supports: AQA Unit 8

Medical instruments are assessed and compared.

STUDY SHEET *Fit for its purpose: the key features needed by a clinical thermometer or blood pressure monitor.* The generic features required by physiological measuring devices are determined by considering clinical thermometers.

STUDY SHEET *Comparing two measuring devices.* Students design and carry out an investigation to determine which of two clinical thermometers or blood pressure monitors is better suited to a particular purpose.

Distribution and abundance of species

Supports: OCR Unit 14 and AQA Unit 16

Students practise sampling methods that can be used in the field.

PRACTICAL SHEET *Simulating investigations of the distribution and abundance of non-mobile species.* Practising how to plan and carry out sampling procedures in the field.

PRACTICAL SHEET *Simulating the mark–release–recapture technique (Lincoln Index) for estimating population sizes of mobile species.* Modelling a sampling procedure to investigate the abundance of mobile animal species that mix freely with each other in the field.

SUPPORT MATERIALS A model of a habitat and the distribution of a non-mobile species can be constructed using simulation sheets printed from the Excel spreadsheets *Distribution of dandelions* and *Distribution of dandelions (less dense)*. Three other useful Excel spreadsheets are also provided on the disc: *Distribution of daisies*, *Distribution of daisies and dandelions* and *Distribution of brown seaweeds*.

Dyes: Industrial scale up

Supports: AQA Unit 13

How various factors affect the scaling up to industrial level of the processes of extracting a natural dye and preparing a synthetic dye.

STUDY SHEET *Industrial scale up.* A case study of Sudan Orange R.

STUDY SHEET *Scaling up your preparations.* Students carry out calculations relating to the scaling up of their extraction method and preparative method of dyes for commercial manufacture – cost, percentage yield and size of reaction vessels.

Ecology and Simpson's Diversity Index

Supports: OCR Unit 14 and AQA Unit 16

Students practise finding Simpson's diversity index using cards and then apply the method to an ecosystem.

PRACTICAL SHEET *Using cards to investigate Simpson's Diversity Index.*

A pack of playing cards and a recording sheet are used to generate a score for the index.

PRACTICAL SHEET *Finding Simpson's Diversity Index for an ecosystem.* Real data are used to make an estimate of diversity.

Enzyme technology

Supports: OCR Unit 15

Students investigate the use of a bioreactor and write a report on their findings.

STUDY SHEET *Investigating a bioreactor.* Students make a bioreactor containing an immobilised enzyme and use it to produce lactose-reduced milk.

STUDY SHEET *Using bioreactors.* Students make a detailed report of the findings of their investigation and relate them to the use of enzyme technology and bioreactors in industry.

FACT SHEET *Bioreactor techniques.* Techniques for immobilising an enzyme, constructing a simple bioreactor, processing with a bioreactor, conducting pilot studies with bioreactors and a dipstick test for glucose concentration using diastix.

Estimating environmental damage in freshwater

Supports: OCR Unit 14 and AQA Unit 16

Students learn how to sample freshwater invertebrates and obtain scores for the Trent biotic index.

STUDY SHEET *The Trent biotic index.* Freshwater invertebrates are used to get scores which may be used to compare water quality at different points in a stream or river.

Extracting and purifying metals

Supports: OCR Unit 12

Students consider how electrolytic cells are used commercially to extract and to purify metals.

STUDY SHEET *Industrial extraction and purification of metals.* Students find out about the industrial extraction and purification of metals and describe the processes in terms of redox reactions.

PRACTICAL SHEET *Refining copper.* An investigation and report on factors that affect the efficiency of a simple laboratory process in which an object is copper plated.

Extracting and testing a natural plant dye

Supports: AQA Unit 13

Students investigate the extraction of natural dyes and use them to dye fabrics.

STUDY SHEET *Natural dyes.* A plant material is selected for dye extraction and fabrics are chosen for dyeing.

INFORMATION SHEET *Extraction and dyeing methods.* A dye is extracted as a solid and in solution, then the dye is applied and its effectiveness is tested.

Impact testing

Supports: OCR Unit 11

Students design and test an impact-testing machine and report on its effectiveness.

STUDY SHEET *Impact testers*. Introduces the scientific principles of impact testing.

STUDY SHEET *Impact resistance of plastic film*. Students are able to develop ideas for designing and testing their own impact testing machine.

Investigating the Wisconsin card sorting test

Supports: OCR Unit 13

Students find out about and use card or computer versions of the WCST.

FACT SHEET *The Wisconsin card sorting test*. Background to and scoring of the test.

PRACTICAL SHEET *Using computerised versions of the WCST*.

PRACTICAL SHEET *Using card versions of the WCST*.

Either using a card or computer version, students carry out a trial implementation of the WCST on a partner to train themselves in its use.

SUPPORT MATERIALS These fact sheets are also useful: *Background to statistics*, *Using Excel for descriptive statistics* and *Using Excel for inferential statistics*.

Investigating thermography

Supports: AQA Unit 8 and OCR Unit 16

Students research the theoretical principles of thermography and create a thermogram.

STUDY SHEET *Thermography*. Students find out about hot body radiation and the medical uses of thermography.

PRACTICAL SHEET *Creating a thermogram*. Temperatures are mapped across an object using an infrared thermometer, then converted into colours to create a thermogram.

Investigating X-rays

Supports: AQA Unit 8 and OCR Unit 16

Students investigate the properties and uses of X-rays for medical imaging.

PRACTICAL SHEET *Investigating shadows*. Use of 'phantoms' to investigate magnification, contrast and sharpness.

PRACTICAL SHEET *Modelling X-ray images of body tissue*. How body tissues can be differentiated using X-rays.

Lung function testing

Supports: AQA Unit 14

Students use a peak flow meter and a spirometer.

STUDY SHEET *Using a peak flow meter*. A procedure to measure peak expiratory flow.

STUDY SHEET *Using a spirometer*. A procedure to obtain measurements of lung capacities such as vital capacity and forced expiratory volumes.

FACT SHEET *Lung function tests using spirometry*. How different measurements of lung volumes can be obtained and used diagnostically.

FACT SHEET *Spirometry*. Information on spirometry and chronic obstructive pulmonary disease

Metals

Supports: OCR Unit 11

Students consider how the structure of metals at the microscopic and atomic levels affects their properties.

STUDY SHEET *Metal structures.* The arrangement of atoms and crystallites is related to the mechanical properties of metals.

PRACTICAL SHEET *Treating metals.* Students carry out tests on samples of metals they have work-hardened, annealed, quenched and tempered.

Microbiology and the pathology service

Supports: AQA Unit 15

Students investigate the pathology service and the kind of work that the scientists do.

STUDY SHEET *The pathology service.* Students find out about the structure and role of the pathology service.

PRACTICAL SHEET *Identifying bacteria.* Procedure for Gram staining adapted from Health Protection Agency Standard Operating Procedures.

PRACTICAL SHEET *General bacterial infections.* Procedure for susceptibility testing adapted from Health Protection Agency Standard Operating Procedures.

INFORMATION SHEET *Working without contamination.* How to apply aseptic technique.

Physics of performance effects

Supports: AQA Unit 10

These activities contribute to the requirements for students to produce a *'portfolio of evidence which considers how light and sound can be used in a performance and the science behind the design of a lighting and sound system in a performance you attended'*.

STUDY SHEET *Sounds good*. Introduction to the science of sound through Milton Keynes Theatre and the study of acoustics at the University of Salford.

PRACTICAL SHEET *Using a swept sine wave to investigate the acoustic behaviour of a room*. Investigating the acoustic properties of a room.

STUDY SHEET *Sound and light This Morning*. The work of sound and lighting engineers on a television programme.

STUDY SHEET *Colour filters*. Using transmission properties to identify colour filters.

INFORMATION SHEET *Luminator*. Facts about a type of spotlight.

STUDY SHEET *Venue check list*. Information for collecting details of the venue chosen for the portfolio.

Preparing and testing a synthetic dye

Supports: AQA Unit 13

Students make a synthetic dye and investigate its effectiveness.

STUDY SHEET *Synthetic dyes*. The chemistry of synthetic dyes.

PRACTICAL SHEET *Azo dyes*. How to prepare and test a synthetic dye.

Researching and planning bioassays

Supports: AQA Unit 12

Students research and use techniques to test and measure the biological activity of two medicines.

STUDY SHEET *Choosing bioassay methods.* Procedures are selected that can be used or adapted for use on two chosen medicines.

STUDY SHEET *Using bioassay methods.* Students carry out and report on bioassays of their two medicines.

Researching and planning chemical assays

Supports: AQA Unit 12

After familiarising themselves with the British Pharmacopoeia, students choose and use two assays for medicines.

STUDY SHEET *Investigating the British Pharmacopoeia.* An introduction to the authoritative collection of standards for UK medicines.

STUDY SHEET *Ibuprofen assay.* A guide through a typical British Pharmacopoeia assay.

PRACTICAL SHEET *Aspirin.* Students compare assaying methods for aspirin and choose a medicine to analyse.

PRACTICAL SHEET *Antacids.* Students choose and use an assay for an antacid medicine.

Scientific investigations: Getting started

Supports: AQA Unit 7 and OCR Unit 8

Students choose, design and plan their own investigation.

STUDY SHEET *A scientific investigation.* Students identify the key features of a scientific investigation.

STUDY SHEET *Choosing an investigation.* Students compile a list of possible investigations, then work up a project plan for one of them.

STUDY SHEET *Planning a scientific investigation.* Students determine aims, design a 'fair test', decide what data they need, carry out a risk assessment and think about ethical issues. Finally they construct an action plan and checklist.

SUPPORT MATERIALS Three factsheets cover data analysis and statistics: *Background to statistics*, *Choosing a statistical test* and *Using Excel for descriptive statistics*.

Scientific investigations: Reporting

Supports: AQA Unit 7 and OCR Unit 8

Students use a checklist to evaluate a scientific report.

STUDY SHEET *Using a checklist to critically assess a scientific report.* Students can appraise any report in the light of the unit marking criteria including a draft of their own report prior to submitting it for marking.

RELATED STUDY SHEETS AND SUPPORT MATERIALS

Planning a scientific investigation (in *Scientific investigations: getting started*)

Three factsheets cover data analysis and statistics: *Background to statistics*, *Choosing a statistical test* and *Using Excel for descriptive statistics*.

The oral glucose tolerance test

Supports: AQA Unit 14

Students investigate the OGTT and its uses.

PRACTICAL SHEET *The oral glucose tolerance test: method 1.* Students use a blood glucose meter to carry out the OGTT.

PRACTICAL SHEET *The oral glucose tolerance test: method 2.* Students carry out a simulation of the OGTT using a chemical method of analysis for simulated blood plasma samples.

FACT SHEET *World Health Organisation guidelines.* WHO guidelines for glycaemic control and the use of the OGTT as a diagnostic test.

Using blood pressure monitors

Supports: AQA Unit 9

These activities provide the standard procedures for methods which could be used to measure blood pressure at the beginning and end of a fitness programme.

STUDY SHEET *Blood pressure measurement.* Methods for automatic digital devices and for devices requiring the use of a stethoscope are provided.

STUDY SHEET *Using an ambulatory blood pressure monitor.* Instructions for using an ABPM for continuous blood pressure monitoring.

FACTSHEET *How blood pressure is measured.* Includes descriptions of auscultatory and oscillometric methods. Manual and automatic methods, including ambulatory blood pressure monitoring, are compared and sources of error suggested.

FACTSHEET *Blood pressure terms and values.* A glossary of terms and hypertensive and some comparative normal values are given.

Waste disposal, recycling and land reclamation

Supports: AQA Unit 16

Students use local authority activities in Somerset to investigate issues relating to waste management.

STUDY SHEET *Waste disposal, land reclamation and recycling in Somerset.*

Students research some of the activities of the local authorities in Somerset and relate them to national issues associated with waste disposal, environmental damage, recycling and conservation.

Wisconsin card sorting test correlational studies

Supports: OCR Unit 13

Students apply correlation coefficients to results obtained using the WCST.

PRACTICAL SHEET *Conducting a correlational study using the WCST.*

Students are given a choice of investigations, gather data, apply a coefficient of correlation and form conclusions.

SUPPORT MATERIALS These fact sheets and Excel files are also useful: *Background to statistics, Using Excel for descriptive statistics, Using Excel for inferential statistics* (describes the use of correlation coefficients, including the use of Excel for Pearson's r), *WCST category sequence*.

Most important to teaching applied science effectively is having clearly in mind its unique character. Unfortunately guidance from the Awarding Bodies in this respect can be inconsistent. Best practice applied science teaching mimics authentic and contemporary workplace practice. Often the approach to science knowledge is techniques-led. If *how science works* underpins science GCSEs and GCEs, then *how scientists (and other practitioners) work* underpins applied science.

advanced applied science

GCE A2 UNITS

This CD ROM is the result of a 4science and Nuffield Curriculum Centre joint project, which developed from work with the Advancing Applied Science teachers' community. The project was made possible thanks to generous support from:

- Gatsby SEP (Science Enhancement Programme)
- The Institute of Physics
- Wellcome Trust

Nuffield
Curriculum Centre



IOP Institute of Physics

wellcome trust



The resource was written, designed and published by 4science.