

GCSE

Edexcel GCSE in Astronomy

Further support for coursework

March 2005

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Further coursework guidance

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Introduction

This supplementary booklet contains further support on coursework tasks and information on how centres can use robotic telescopes as part of their coursework. This booklet brings together information from the Examiners and from the companies that operate the three main robotic telescopes in Britain. Further information about these telescopes is given here, but can also be found by accessing their websites from the Edexcel GCSE Astronomy webpage (useful websites). Edexcel does not endorse any of these telescopes. We are providing access to more detailed information to allow centres to choose for themselves with more confidence. The following information has been provided by each of the robotic telescope organisations.

All of the information listed here should be used in conjunction with the specification. Any queries regarding coursework tasks should be referred back to the Assessment Leader for GCSE Astronomy at Edexcel.

Further exemplar coursework tasks

This list contains some further exemplar tasks that could be carried out as part of the coursework, and which match the assessment criteria. These tasks can be used for coursework as well as the tasks on the lists on pages 22, 24 and 26 of the specification.

Please contact the Assessment Leader for GCSE Astronomy at Edexcel before allowing the students to proceed with any other tasks that do not appear on any of these lists. The new task must satisfy the assessment criteria (on pages 23, 25 and 27 of the specification) in order to be suitable.

List A – Observations

- Use of shadow stick and clinometer to determine latitude and longitude
- Observations of Algol (Beta Persei)
- Drawings/photos of eclipse, transit etc
- Constellation photography
- Solar spectrometry.

List B1 – Graphical and computational work

- Use of a spreadsheet to plot a H-R diagram
- Use of a spreadsheet to show planetary motion through the zodiac
- Use of PowerPoint to illustrate an aspect of Astronomy such as Stellar Evolution.

List B2 – Constructional work

- Construction and use of simple Spectrometer
- Simple Orrery
- Simple Moondial.

Remote access robotic telescopes

Robotic telescopes can be used as part of the coursework, for *List A – Observations*. The students have to request what the telescope observes, therefore this is similar to observing through a standard telescope. The robotic telescopes are sited in locations that do not suffer from the same optical and chemical pollution as we get in Britain. Their altitudes are much higher so there are more clear nights for observing.

It is important to make the distinction between sites which allow students to produce their own observational data (eg robotic telescopes) and those which simply provide a gallery of images which have been obtained previously by other astronomers. The former clearly represents an exciting and tremendously powerful way for students to take observations and lie fully within the spirit of the criteria for the tasks in *List A – Observations*. However, images obtained through the latter method cannot themselves be given credit under the 'Observations' section of the assessment criteria. If students have used these images as the basis for further analysis, such as calculating orbital periods of satellites, sunspots etc, then credit could be given under the 'Detailed observations/deductions' section of the criteria.

There are three main robotic telescopes available for centres to use. These are:

- Bradford Robotic Telescope
- Faulkes Telescope Project
- National Schools Observatory

Further information about these telescopes is given here, but can also be found by accessing their websites from the Edexcel GCSE Astronomy webpage (useful websites). Edexcel does not endorse any of these telescopes. We are providing access to more detailed information to allow centres to choose for themselves with more confidence.

The following information has been provided by each of the robotic telescope companies.

Bradford Robotic Telescope

The Bradford Robotic Telescope (www.telescope.org) is a free resource to aid in the teaching of astronomy and astronomy research. The Bradford Telescope is unique in the fact that it is free to use and there is no need to book a time slot to use the telescope. The telescope deals with scheduling and taking of images, leaving you free to get on with the other aspects of astronomy.

Structured learning programmes are being developed for KS2-KS4 students covering the British national curriculum. Activities are complemented by a learning management system and a range of teacher's aids. The aim is to provide a complete teaching resource for learning astronomy in the classroom.

Taking and ordering images is easy and a large number of different cameras are available for imaging the many wonders of the night sky:

- The Galaxy Camera – Field of view: 20 arc min square. Suitable for taking images of planets and their moons, galaxies, nebula, comets and close up images of the moon.
- The Cluster Camera – field of view: 3 degrees square. Suitable for taking images of clusters and the whole moon.
- The Pole Star Camera – field of view: 25 degrees square. Suitable for viewing the nightly and yearly motions of the stars caused by the motion of the earth.
- The Teide Camera – field of view: 20 degrees square. Suitable for viewing the rising and setting of the stars on a nightly and yearly basis.
- The Constellations Camera – field of view: 40 degrees square. Suitable for imaging the constellations and the motion of the planets through the stars.

An extensive range of object catalogues are available. As they are grouped by the type of object they allow the easy selection of items from Nebulas to Planets. Users that don't know where to find the best objects in the night sky have all the work done for them. The number of possible coursework investigations allowed by the image catalogues is almost limitless:

- Searching for comets. Taking multiple images of a comet on a number of nights shows its movement through the other stars; you can search for unknown comets in space by monitoring the same patch of sky over a number of nights and looking for slight changes in position of at what at first appearance look like stars.
- Using the life cycle of stars in a cluster to predict the age of the Milky Way galaxy.
- Using globular clusters to calculate our distance from the centre of the Milky Way galaxy.
- Measuring the motions of the planets to work out the length of the planets years and building a model of the solar system.
- Monitoring the moons of Jupiter, Neptune or Uranus as an investigation into the formation of moons and gravity.
- Using the moons of a planet to work out its mass.
- Using craters on the moon to predict the possibility of a collision of an asteroid with the earth.
- Classifying galaxies using the Hubble classification system.

Images are produced as FITS files, which are the standard astronomical format. This format allows for far greater pixel depth in the image, this greater range of contrast in the image is larger than the range given in the standard screen display or the human eye can see. Dedicated online software allows you to fully manipulate images without the need to install new software onto your computer.

Getting started is easy all you need to do is visit www.telescope.org and sign up for a free teachers account with the telescope. There's no software to download or install – it all runs through a standard internet browser.

Faulkes Telescope Project

The Faulkes Telescope (FT) project provides UK schools with a unique educational resource – two large (2m diameter primary mirror) robotic telescopes, equipped with research-grade astronomical instruments, and located at professional observatory sites in Hawaii (FT-north – Maui) and Australia (FT-south – Australia). The telescopes are funded by the Dill Faulkes Educational Trust, and are controlled by students over the Internet. The telescopes are located in different time zones, Hawaii (-12 hours) and Australia (+10 hours) which allows their use in classroom hours.

- **What astronomy can I do?**

Schools can do short activities or participate in real astronomical research through the FT education/research projects. Students will gather data to study asteroids and comets (maybe even discovering new objects!), colliding galaxies and exploding stars.

- **How are the telescopes used?**

The telescopes operate in two modes:

- (i) **Off-line** – requests for observations are submitted, and are emailed the data within days
- (ii) **Real-time** – a unique and exciting feature of the FT project is the ability to operate the telescopes in real-time and view them via a webcam. Slots of 30 minutes duration are booked in advance.

- **Are support materials available?**

Experts in astronomy and secondary science, maths and ICT have developed educational support materials. All the materials are available on the website.

- **Can you use the telescopes even if you don't know any astronomy?**

Yes, the web pages that you use to access the telescopes are written so that you don't need to know anything about astronomy. There are 'guided tours', which lead you on a journey of exploration through the Universe for those with no previous experience

- **How much does it cost for schools to use the telescopes?**

A one-year subscription to the project costs £160 plus VAT. This gives the school 3 half hour live observing sessions and 10 minutes of off-line time. More time can be bought on top of this.

(This rate for schools is heavily subsidised by the Dill Faulkes Educational Trust and the cost to other users is higher.)

- **How do I register and find out more information?**

To register to use the telescopes visit the following webpage:

www.faulkes-telescope.com/newusers.htm

National Schools' Observatory

The National Schools' Observatory (NSO) is an Internet-based resource providing students with access to a state-of-the-art research grade fully robotic telescope. Further information is provided on our website: www.schoolsobservatory.org.com

The Liverpool Telescope (LT), operated by Liverpool John Moores University, is sited on top of an extinct volcano on the island of La Palma in the Canary Isles. The University has allocated observing time on this instrument for students to use alongside professional astronomers. Students can observe the night sky through this world-class telescope and gather their own data for coursework and related projects.

To use the telescope students select the **Go Observing** pages on the NSO website where help is provided with choosing objects to observe. Go Observing also provides a range of observational programmes to stimulate ideas and provide data for coursework projects. Examples of such projects include: measuring the length of the day on Jupiter, determining the orbital period of a planetary moon, discovering asteroids, classifying galaxies and much more. Observing programmes are continually being added, including special *observing projects* found on the **Universe Lab** pages of the website. Once an observation programme has been selected it is submitted and sent to the telescope. Students can follow its progress and once the observation has been completed it is ready to be downloaded from the NSO web site (Go Observing pages). At this point the observation(s) are displayed and measurements can be taken using **image processing software** (LTImage) designed by the University. This software is available free when schools register with the NSO.

The NSO website is a rich source of information and activity for students ranging from using the simple astronomy textbook, simulations of the phases of the Moon to workshops and the NSO investigations. The **Staff Room** section provides teachers with information about available resources and where they are found on the website.

To use the telescope schools must first register with the NSO online:

www.schoolsobservatory.org.uk/staff/register

The annual subscription is just £50 and provides access for students to use the Liverpool Telescope for one year and a copy of the NSO CD-Rom.

The NSO CD-Rom contains the following software:

- LTImage – Image processing software to display and analyse LT data.
- LT3D – Simulation of the Liverpool Telescope.
- LTRobot – 'Virtual' Liverpool Telescope – explore night sky from your desktop.
- NSO website – A copy of the website for use at a 'local' level.

A site licence for all NSO software is automatically allocated to each school on registration and entitles the registered school to make copies of NSO software for educational purposes within the registered school. This licence also entitles a registered school to make one copy of the software available for students to use on their personal home computer as part of a schools' educational programme. Teachers can also make a personal copy of the software.

Once registered schools can allocate students with **Student Passwords** so that they can work independently and use the Liverpool Telescope for their coursework and further interest.

The NSO is an exciting complementary resource for the GCSE Astronomy course bringing the world of the professional robotic telescope into the hands of young people.

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