ASTRONOMY TEACHING AT THE OPEN UNIVERSITY

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1. The Open University

The Open University is a distance-learning institution – students do not come to a central campus but study from where they live or work. Course materials are delivered to the student and consist of specially prepared texts and audio-visual materials. In addition, an increasing number of courses require the student to have a computer with access to electronic communications. For each course a student has a course tutor who offers tutorials, telephone contact, and who marks and comments on student work. Some courses have a residential school or day schools, and students can study full-time or part-time.

The length of a course is specified in accord with a UK system called CATS points. A single CATS point represents 10 hours of work for the average student; full-time study for one year requires 120 CATS points. Most OU courses are either 30 or 60 CATS points, though some 10 and 15 point courses are being introduced. Students accumulate points until they have sufficient for a diploma (240 points) or for a degree (360 points) and have great freedom in course choice, with no formal pre-requisites for entry onto any course.

2. The Astronomy and Planetary Science Curriculum

Courses for the Astronomy and Planetary Science (A&PS) curriculum at the OU are written by teams whose members are drawn from the University’s Department of Physics and Astronomy, Department of Earth Sciences and the Planetary Science Research Institute. Each of these departments has a strong and active research base with particular strengths in stellar and planetary physics. Undergraduate courses are presented at one of three
levels, each of which roughly maps on to the corresponding year of study at a conventional university. In addition to this, there are full programmes of postgraduate study, leading to PhD, in each department.

2.1. LEVEL 1 COURSES

We offer a 60 CATS point Science Foundation course ‘Discovering Science’ (S103) which is studied by around 5000 students each year. This comprises twelve blocks which introduce major themes of the main science disciplines. Block 3 ‘The Earth and its place in the Universe’ provides an introduction to astronomy and planetary science; Block 11 ‘Universal Processes’ covers introductory cosmology and particle physics; and Block 12 ‘Life in the Universe’ uses previously published journal and magazine articles to allow students to study the search for life elsewhere in the Solar System and beyond.

A new course for 2000 is a 10 CATS point ‘taster’ course ‘An Introduction to the Cosmos’ (S194) which is based around a glossy, full-colour picture-book of astronomical images. It is intended to provide an interesting and enjoyable access point to our second level A&PS course. In the future, we intend to produce further 10 CATS point courses on topics such as ‘The search for extraterrestrial intelligence’, ‘Exploring the Solar system’ and ‘Black holes’.

2.2. LEVEL 2 COURSES

We have a very successful 30 CATS point course, called simply ‘Astronomy and Planetary Science’ (S281) which is studied by around 1200 students each year. The course comprises four books: ‘The Stars and the Interstellar Medium’, ‘The Planets’, ‘Galaxies’ and ‘Cosmology’. The course has been in existence since 1994 and it is planned to revise and expand it for new presentation in 2003 as a 60 CATS point offering. In its revised form, it will comprise four 15 CATS point stand-alone modules with a new, final book on the topic of ‘Life in the Universe’ (with the last two books of the original course combined into a single module).

2.3. LEVEL 3 COURSES

A very innovative course which sits at level three is ‘Space, Time and Cosmology’ (S357), a 30 CATS point course covering topics in special and general relativity and cosmology. This course attracts around 500 students each year. As befits its level, it is a fairly mathematical course and strongly advises students to have some background in level two physics and mathematics before embarking on it.
A new presentation at level three in 2002 will be the 30 CATS point course ‘The Energetic Universe’ (S381). This will be based around a series of existing set-books, accompanied by Study Guides which address three topics in contemporary high energy astrophysics. After an introductory block which provides an introduction to the field as well as revising the necessary mathematics, physics and astronomy, students will embark on ‘The Life and Death of Stars’, ‘Interacting Binary Stars’ and ‘The Violent Lives of Galaxies’.


2.4. CURRICULUM DESIGN

The content of all our courses is decided at the level of the course team – a group of typically 4-6 academics who will also call on the advice of an external ‘course assessor’ during course production. At level 1, the main driver for course content is one of perceived student interest. We aim to include topics that are above all interesting, so that we can attract the maximum number of students. For instance, the origin and history of the Universe is a major theme of S103. At level 2, our priority changes and the aim here is to provide courses with as broad a coverage of the subject area as possible. All conventional topics within the astronomy and planetary science umbrella are introduced in S281. At level 3, course content is decided by a more diverse range of considerations. Partly, we are guided by the research interests of the course team members, as exemplified by the coverage of interacting binary stars in S381. However, we also use the subject material to teach aspects of physics in the context of astrophysics. In this respect S357 is a good example, using cosmology as the context for teaching special and general relativity. Finally, our level 3 courses are guided by a desire to include contemporary material and to actively reflect the focus amongst the research community. An example here is the inclusion of active galaxies in S381, an area involving 20% of all research active astronomers.

Ensuring that our courses continue to reflect current research is a major challenge, given the way in which our course material is delivered. All courses are re-made on a timescale of around eight years, but this can cause dating problems. To alleviate this, both S281 and S357 have an annual Yearbook which covers the important developments in the field over the past 12 months. Another way we address this problem in S381 is that students will download journal articles and astronomical data from the internet and be guided by a course web page to up-to-date information sources.
3. Non-printed Media

Although printed books, produced in-house, have always been the main part of any OU course, we have also made extensive use of TV/video, radio/audio tape, and home experiment and residential school practical work in many courses, including astronomy courses. In recent years this has been augmented by CD-ROM based material, and in future WWW based resources are likely to be widely used. Three examples below illustrate the use of computer-based media in some of our current and future courses.

3.1. MULTIMEDIA IN THE SCIENCE FOUNDATION COURSE

The material for Block 11 of S103 includes a CD-ROM containing two multimedia packages. The first of these ‘The Virtual Telescope’ is a virtual experiment to determine the Hubble constant (Figure 1). With the help of an on-line virtual support astronomer, students are guided through photometric and spectroscopic observations of eight clusters of galaxies in order to measure the brightness of a standard member galaxy (and hence its distance) and the redshift of the cluster (and hence its speed of recession). Real data (digitized sky survey images and galaxy spectra) are included.

The second package ‘The History of the Universe’ is a comprehensive resource which contains information about all the universal physical processes that have occurred since the Big Bang (Figure 2). Material is searchable.
via a time-line, via keywords, or via hyper-linked topics and includes video
clips, animations, graphics, interactive demonstrations, as well as audio
commentary and textual information.

3.2. VIRTUAL EXPERIMENTS AT LEVEL TWO

Given the large numbers of students who take our courses each year it is not
feasible to provide them all with access to real telescopes on a regular basis,
but virtual experiments enable similar skills to be developed. For the revised
version of S281 we anticipate that students will be supplied with a series of
virtual astronomy experiments, such as the excellent packages produced by
Project CLEA (Contemporary Laboratory Experiences in Astronomy) at
Gettysburg College (http://www.gettysburg.edu/academics/physics/clea/
CLEAhome.html). These span topics such as ‘Radio Astronomy of Pulsars’,
‘Photometry of the Pleiades’ and ‘Classification of Stellar Spectra’.

3.3. WWW RESOURCES AT LEVEL THREE

Astronomy is fortunate in that there is a vast resource of astronomical data,
images and journal articles freely available over the internet. As part of our
level three course S381 we intend to include use of such material as an inte-
gral part of the course. Students will be guided to a variety of information
sources, via a course WWW page, in order to carry out activities including
4. The Student Body

At the OU it is not possible to get a degree in astronomy, though in a few years time it will be possible to get a joint degree in which astronomy accounts for about half of the CATS points. The named degree ‘Natural Science with Astronomy and Planetary Science’ will include all the available A&PS courses plus several physics courses.

OU science students have a mean age of about 30, and a high proportion are getting degrees to help them advance their existing careers, or to switch careers, but rarely into astronomy. Unsurprisingly, people who work in some area of technology, science, or science education, are a larger proportion of the students of astronomy courses than OU students in general. Since astronomy is a small profession compared to physics, it is therefore likely that only a small proportion of students obtaining the A&PS named degree will proceed to postgraduate and postdoctoral work in astronomy. Currently an extremely small proportion of students taking the existing A&PS courses in the context of different degrees intend to enter the profession. Nevertheless, undergraduate astronomy at the OU is very popular, with S281 enrolling 2-4 times more students than the level two courses in physics, and more than almost any other Level 2 science course. At level three S357 enrols about double the number of students that take the Level 3 physics courses. The astronomy content of S103 is rated as exceptionally interesting by students.

Astronomy is a popular ingredient of a wide variety of science degrees, not only in physics, but also in Earth science, and in general science. It helps attract people to science, it helps sustain their interest in science, and it enables us to teach basic science, particularly physics, to a lot of students and to develop a range of transferable skills.

5. The Development of Information Handling Skills

Skills development is a major feature of all OU Science courses, and those in the A&PS curriculum are no exception. In particular, the field of astronomy is particularly well suited to the assimilation of information handling skills. Through our range of courses in this area we attempt to provide a progression in the development of such skills and enable students to build on this key transferable skill in their subsequent careers. As a result of the popularity of astronomy, the subject once again will be fulfilling the role of drawing many people into the physical sciences and teaching them knowledge and skills of wide usefulness.

See: http://www.open.ac.uk/ and http://physics.open.ac.uk/