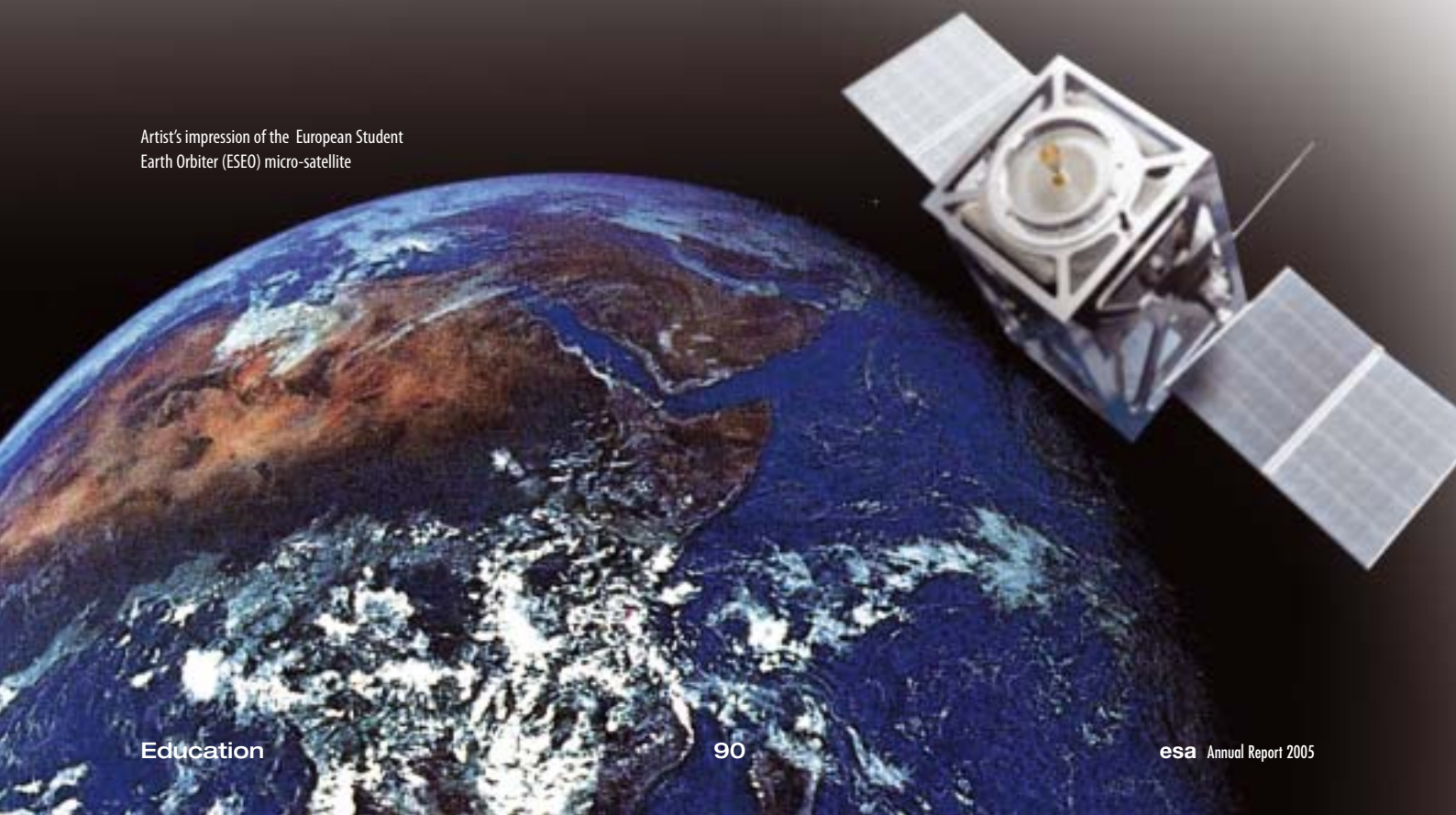
Education

Europe is facing a severe decrease in young people's interest in science, engineering and technology (SET) subjects, as well as a decline in the uptake of SET careers. This general disinterest, particularly on the part of young women, is more evident in the classical SET school and university subjects, such as mathematics, physics and chemistry, than in emerging fields such as information and communications technology or the applied sciences, such as medicine and biotechnology. Combined with an overall ageing of the European SET workforce, this trend could have serious consequences, affecting not only the future tertiary education systems in Europe, but more importantly the SET-related industries and their employment markets. Moreover, without an appropriate quantity and quality of human expertise in SET-related areas, the basis for a knowledge-based society and economy in Europe will be jeopardised.

Although education was included from the outset as a basic activity in the ESA Convention, it is only in the last few years that a dedicated education effort has been undertaken both at corporate level and within the Directorates. The importance given to education in both Agenda 2007 and the EC White Paper led the Director General to establish, late in 2004, an overall policy that centralises all activities inherent to education within the Education Department. As a result, a new operational structure for education activities has been set up, aimed at a joint effort by the Education Department and Directorates to implement a common strategy according to a corporate set of rules. It was then decided: to pursue a new and ambitious project called the 'European Space Education Resource Office (ESERO)'; to re-structure the hands-on activities for young people, in particular university students; and to reinforce cooperation with Member States, the EC and other international space agencies and organisations.

ESERO

Reaching the primary target audience directly, i.e. millions of students, professors and teachers, is an impossible task for ESA. In addition to the various languages, the educational systems are very different from one Member State to another. Therefore, to implement its education policy efficiently the Agency had to opt for a 'Member State by Member State approach'.



Artist's impression of the European Student Earth Orbiter (ESEO) micro-satellite

ESERO's objective is therefore to establish contact points (ESA contractors - preferably located at existing facilities) in all ESA Member States who are education experts, already well integrated into the national educational systems and networks. This should allow the Education Department to support the specific educational needs of the Member States and to gain easy access to the existing national networks (publishers, museums, teachers' associations, etc.). ESERO, whose primary task is to share the enthusiasm for European space exploration, will be responsible for the development of close relations with national education stakeholders and the participation in education activities tailored to the specific situation in each Member State. It will promote SET careers in the European space sector and provide support for the delivery of national curricula.

To maximise the chances of success, it was decided – with the full support of the ESA Delegations concerned – to begin the project's implementation with three ESERO contact points, in Belgium, The Netherlands and Spain. The first contract was signed in late 2005 with the National Science and Technology Centre (NEMO) in Amsterdam. Sharing ESA's objectives, the Dutch Government is co-funding the initiative. The contracts with Belgium and Spain are expected to be signed early in 2006. The United Kingdom, via 'Yorkshire Forward' a regional development agency, has also shown strong interest in the project, and the possibility of installing several ESERO contact points throughout the UK is now being studied in collaboration with the British National Space Centre (BNSC). An overall evaluation of the pilot projects is planned at the end of 2007 and a decision on whether to further expand into other Member States will then be taken. If positive, at least one office per Member State will be opened by 2010 at the latest.

Hands-on Projects

ESA's educational hands-on projects are designed to provide university students with practical experience in real space projects and to enhance their motivation to pursue a career in the fields of space technology and science, thus helping to ensure the availability of a suitable and talented workforce in the future. High levels of academic expertise in specific space-related fields exist throughout European universities, but these units currently operate independently of each other. The hands-on projects of the Education Department have the potential to combine these isolated centres of expertise, offering students access to a powerful network capable of designing, developing, integrating, testing, launching, and operating intricate and technologically challenging student spacecraft and payloads. Student hands-on projects include the development and operation of small satellites, provision of payloads for satellites, parabolic-flight campaigns, sounding-rocket and stratospheric-balloon flight campaigns, and student spacecraft mission-design workshops. It is estimated that about 5000 students will be involved in these projects over the next ten years, and that more than 100 Masters and PhD theses will result.

Satellite Projects

The Student Space Exploration and Technology Initiative (SSETI) consists of a series of three micro-satellites:

- Express, a 62 kg satellite successfully launched on 27 October by a Cosmos-3M from Plesetsk (Russia) into a low-Earth, Sun-synchronous orbit
- the European Student Earth Orbiter (ESEO), a 120 kg satellite to be launched at the end of November 2008 into a Geostationary Transfer Orbit (GTO)
- the European Student Moon Orbiter (ESMO), a 240 kg spacecraft to be launched in 2011/12 into GTO and then transferred, using a combination of chemical and electric propulsion, into a lunar orbit.

The micro-satellites are designed and built entirely by student teams. The ESA Education Department provides network facilities for the teams to exchange information and discuss problems, solutions and schedules, identifies a suitable launch vehicle and covers the launch costs, provides technical and management coordination, organises and sponsors regular workshops at ESTEC during which the student teams can receive advice from ESA experts, manages the integration and testing of the spacecraft including the provision of the test facilities, and manages the launch campaign.

The highlight of the year was the successful launch of ESA's first student satellite SSETI Express on 27 October. Unfortunately, the mission lasted only 12.5 hours because the solar array was unable to charge the batteries due to an electrical power subsystem malfunction. Nevertheless, in lots of respects the mission was still a great success and

The launch of SSETI Express from Plesetsk in October

many valuable lessons were learned. Of the 19 subsystems onboard, 12 operated successfully, five could not be tested because the mission ended prematurely, and only two failed (one of which had a backup). The media impact was enormous, with the televised launch being watched by an estimated 100 000 000 viewers.

Another series of micro-satellites is the Young Engineers' Satellite (YES) programme. YES 2, currently being prepared for launch into a low Earth orbit, together with a Russian Foton-M3 capsule, in September 2007, consists of three elements, two of which will be lowered from Foton-M3 using a 32 km long tether to reduce orbital energy. Once the tether is fully unreeled, it will be cut and a small spherical capsule called 'Fotino' will re-enter the Earth's atmosphere and land in Russia. The Fotino payload comprises a GPS receiver, thermocouples, accelerometers, pressure sensors, gyroscopes, and a magnetometer; a parachute will reduce the impact velocity to less than 10 m/s.

A 710 kg spacecraft is foreseen for launch on the maiden flight of ESA's new small launcher Vega in November 2007. The allocation of 75 kg for an educational payload entirely provided by students is under discussion. It would comprise a GPS receiver, a camera, a data-handling and power interface unit, a downlink telecommunications system, six pico-satellites, and a physics and a biology experiment box.

Student Parabolic Flight Campaigns

The 8th campaign took place from 12 to 29 July in Bordeaux. A total of 145 students participated, 120 of them flying aboard the Airbus 300-Zero G aircraft. They performed 30 physics, chemistry, biology and life-sciences experiments under microgravity conditions, with the Airbus flying 130 parabolas, each providing about 20 seconds of microgravity conditions.

Sounding-Rocket Campaigns

In 2005, exploratory discussions were held with representatives from Esrange (Sweden) and the Andoya Rocket Range (Norway) to explore the possibilities for European students to fly small payloads (typically20-30 kg) to an altitude of 100 km on sounding rockets. As a result, the first launch of an experiment selected by the Education Department will take place from Esrange in April 2006.

STRAPLEX

The STRAtospheric PLatform EXperiment is a collaboration between Portugal's University of Porto and the ESA Education Department which began in 2005. It offers

Participants in the 8th Student Parabolic Flight Campaign in July

European students the possibility to send experiments into the stratosphere using balloons filled with helium, and also to participate in future capsule development. The balloons, to be launched from Evora (Pt), can reach altitudes of up to 40 km, depending on the mass of the payload attached. Other launch sites will be Madeira and Kiruna (S). The first qualification flight took place on 19 December. Starting in 2006, two campaigns each involving six balloon launches are foreseen every year.

SCDE and Mission Design Workshops

The distribution of the Student Concurrent Design Environment (SCDE) started in 2005 with the International Space University (ISU) as the first 'customer'. This enabled the Department to receive feedback with which to improve the design tool before it is distributed to a wider community. It is now being distributed via the ESA Portal to other universities.

The second Student Mission Design Workshop, using the Concurrent Design Facility (CDF) at ESTEC, will take place in 2006 and be devoted to the ESMO mission.

Science on Stage: David Featonby (UK) demonstrates magic tricks based on physics

Student Participation at Conferences

Presentation of the results obtained by the students is regarded as an integral part of the hands-on projects. 81 students were therefore selected (from almost 400 applicants) and sponsored to present papers at the 56th International Astronautical Congress (IAC) in Japan in October. The Department also made a major contribution to the Congress's International Student Zone (ISZ), in cooperation with NASA, CSA, and JAXA. During the year, the Education Department also sponsored a number of students participating in Masters courses and Summer School sessions.

Science on Stage

Science on Stage is a unique, week-long, European-wide festival for science teachers that takes place every 18 months to assess the current situation in science education and to identify innovative teaching methods and projects in physics and related sciences. The Education Department has been the main organiser of this event since the beginning in 2000. In 2005, it was held from 21 to 25 November at CERN in Geneva (CH) and more than 400 teachers from 35 countries participated. There were 20 national events leading up to the main festival, some of which were also supported by the Education Department.