

Hitting cancer's self-destruct button



Pipeline leak detection system
mimics the human body



Record Growth Anticipated
for Scottish Biotech



Directory of Scotland's
Science Infrastructure



Introduction

Welcome to the first issue of **Science Scotland**, a new project devoted to the inventiveness and vision of Scottish scientists.

Scotland has a large and well proven history of original thinking and pioneering research. It's a heritage that we at the Royal Society of Edinburgh are proud of and celebrate.

But Scotland's contribution to global science isn't just a matter of history. Today, in the rapidly changing world of the 21st century, from nano-technology to molecular genetics, engineering and medical research, artificial intelligence, biotechnology and drug discovery, the quality of Scottish scientific research today is world leading - we aim to ensure that it's also world renowned.

This magazine is just the first step in a wide-ranging venture to encourage informed debate and knowledge-sharing about the scientific advances coming out of Scotland today. In this issue, we've highlighted only a few. We could have featured many more.

For now, I urge you to read and enjoy this first issue of our magazine. I hope that it stimulates ideas and discussion and gives an idea of the inventiveness and originality of Scottish science. Please visit the accompanying website at www.sciencescotland.org for additional links and latest updates, as they happen.

If you would like to follow up any of the stories featured in this or future issues of **Science Scotland**, please get in touch via the website. We'd love to hear from you.

Best wishes,

Sir William Stewart FRS FRSE

Former President of the Royal Society of Edinburgh

Science Scotland is published and distributed with support from the Royal Society of Edinburgh, Scotland's National Academy of Science and Letters.

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SCOTTISH EXECUTIVE



SCOTTISH DEVELOPMENT INTERNATIONAL

Micro and Nanotechnologies Conference 2004 - 30th May-3rd June



Leading lights in the world of precision engineering and nanotechnology will meet in Glasgow later this year to enjoy a five-day programme of events and presentations.

The 4th International Conference and 6th Annual General Meeting of the European Society for Precision Engineering and Nanotechnology (EUSPEN) takes place at the SECC in Glasgow with a programme that includes research presentations, optional tutorials and tours, and a commercial exhibition.

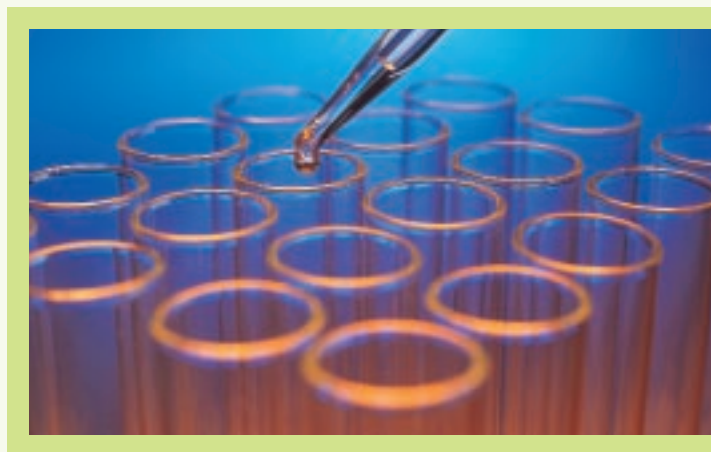
More details, including session titles for abstracts, can be found at www.glasgow2004.euspen.com

Edinburgh Scientists To Fight Diabetes and Obesity

Scientists are to research why overweight people find it so hard to diet, following a record-breaking European Union research grant of €11.7 million.

Two University of Edinburgh professors will take part in the major collaborative project, which involves leading names in the field of obesity research from thirteen European countries.

The new study builds on previous research which shows that the brains of people who have been overweight for a long time reprogramme to accept the extra fat as "normal". The reprogrammed brain then views dieting as a threat to the body's survival. As a result, when obese people reduce their food intake, the brain's control system decreases the body's metabolic rate



which in turn slows the burning of calories. Professor Jonathan Seckl, of the molecular medicine department at the University of Edinburgh, explains: "Overall, this brain reprogramming tends powerfully to maintain the body weight against attempts to diet. Our goal is to find out how this works and then to identify four or five new gene targets in the body which can be influenced by medicines to cure obesity and its serious consequences, diabetes."

Professor Gareth Leng, of the university's department of experimental physiology, will also work on the five-year project.

Obesity is implicated in 100,000 deaths every year in Britain. The American Obesity Association estimates that approximately 127 million Americans are overweight, 60 million are obese and 9 million severely obese. (www.obesity.org)

Scotland Comes To BIO 2004 - 6th-9th June

Visit the Scottish Pavilion at the BIO 2004 Annual International Convention in San Francisco this summer and find out more about life sciences in Scotland.

BIO 2004 provides a forum for emerging technologies, industry networking and business development, and this year's convention promises to be the largest gathering of biotechnology leaders in the world.

The Scottish Pavilion at Stand 445 will showcase around a dozen leading life sciences companies and universities from Scotland, with a further twenty being represented at the stand.

More details are available at www.bio.org/events/2004

New Evidence For Solar-Like Planetary System

Astronomers in Edinburgh have produced compelling new evidence for the existence of Earth-like planets orbiting a nearby star.

New computer modelling techniques used by astronomers at the UK Astronomy Technology Centre at the Royal Observatory in Edinburgh have shown that observations of a faint dust disc around the star Vega can be best explained by a Neptune-like planet orbiting at a similar distance to Neptune in our own Solar System.

The observations were taken with the world's most sensitive submillimetre camera, the Submillimetre Common-User Bolometer Array (SCUBA), which was built in Edinburgh and is attached to the James Clerk Maxwell Telescope in Hawaii.

"The irregular shape of the disc is the clue that it is likely to contain planets," explains Royal Observatory astronomer, Mark Wyatt. "Although we can't directly observe the planets, they have created lumps in the disk of dust around the star."



The modelling suggests that the Neptune-like planet actually formed much closer to the star than its current position, indicating that the Vega system might have evolved in the same way as our own Solar System. This theory will be tested by making further observations after a gap of a few years, to observe any movement of the clumps. The next generation of cameras and telescopes should also shed further light on the subject. Watch this space.

Aberdeen Academic Measures Up

An Aberdeen academic has been awarded the highest international accreditation for his contribution to the scientific specialisation of kinanthropometry.

Dr Arthur Stewart, University of Aberdeen's Sports Studies Degree Co-ordinator, is only the eleventh person in the world to achieve the ISAK (International Society for the Advancement of Kinanthropometry) Criterion Award.

Much of his work focuses on understanding the anatomical factors behind human performance and in the last two decades he has measured over 2,000 people to support ongoing research into sports performance, osteoporosis, body image and obesity.

5

Science Matters

The independent Scottish Science Advisory Committee (SSAC), a key part of the Scottish Executive's Science Strategy for Scotland, was created in May 2002 under the auspices of the Royal Society of Edinburgh.

The SSAC was set up to inform policy and advise Scottish Executive Ministers on science strategy, science priorities and science policy. The Committee membership represents a breadth of expertise and knowledge across a range of scientific disciplines and interests including education, business, engineering, technology, medicine, ethics and public engagement. The SSAC has recently published



its first two reports: *Science Matters* and *Science Education Matters*.

Science Matters calls for all aspects of science activities in Scotland to be optimally connected to deliver the best outputs from Scotland's well-recognised international excellence, while *Science Education Matters* calls for a fundamental review of school science education to ensure it addresses the challenges and rises to the opportunities of the 21st century.

The reports can be downloaded from the SSAC website: www.scottishscience.org.uk



Pipeline leak detection system mimics the human body

How a cut finger led to pipes that heal themselves

When an engineer from Aberdeen University got a paper cut while reading research papers on the train, it led to a Eureka moment that could save the oil and water industries millions of pounds.

"I was actually reading about leakage problems in the UK water industry," explains Dr Ian McEwan, "when I cut myself on a piece of paper. Sitting there, holding my finger, it occurred to me that the human body does an excellent job sealing leaks. The obvious question was whether we could use the body's elegant solution to the leakage problem and adapt it for use in engineering."

By the end of the journey he had the nucleus of an idea for an innovative pipeline monitoring system that combined leak detection and repair.

Named ATLLAS (Advanced Technology for Leak Location and Sealing), the process developed by Dr McEwan and his team is based on the bio-physical analogy with the human body's own leak defence system.

Tests were first carried out using a specially designed flow-loop to characterise leakage in pressurised pipes. Data from a sensor array that was passed along the inside of the pipeline showed that a depressurised zone existed over the orifice created to simulate the

leak. This depressurised zone caused the resultant fluid forces to entrain appropriately designed free-moving objects into the orifice.

This discovery led to the development of the Platelet, a free-floating device designed to take into account flow velocity, pressure, product density, pipe diameter, leak geometry and leak size. The design is aided by advanced strength modelling using finite element methods as well as flow modelling using computational fluid dynamics simulations of both fluid and Platelet behaviour near a leak.

ATLLAS uses the fluid flow inside a pipeline to deliver these specially designed, polymer-based Platelets to the site of a rupture, where they are pulled into the leak and held in position by the pressure differential acting across them. The extreme pressure causes the Platelets to deform and meld together, temporarily plugging the leak. Tiny transmitters embedded into each Platelet allow pipeline operators to pinpoint the exact location of the fault.

Different situations require different Platelet specifications. Some applications emphasise the sealing capability whereas others may stress leak location. The exact specification of the material, which is inert and non-toxic, is part of this design process and takes into account strength requirements, ambient conditions and chemical compatibility with the product being transported in the pipeline.

The concentration of Platelets is sufficiently small that the effective density of the fluid is unchanged and excess Platelets can be removed from the flow using a downstream strainer system.



Just four years after that inspiring train journey, a spin out company, Brinker Technology Limited, was formed to market ATLLAS technology. Since then, the company has attracted interest, and investment, from leading players in the global energy sector.

The technology is currently being developed for use in the North Sea Oil industry with the support of a Scottish Enterprise Proof of Concept Award.

"ATLLAS" and "Platelet" are registered trademarks of Brinker Technology Ltd.

Dr Ian McEwan is holder of a silver medal for innovation from The Gannochy Trust.

"The analogy with the human body only takes it so far. We then had to actually adapt that so it could function in a pressurised pipeline."

Dr Ian McEwan



Hitting cancer's self-destruct button

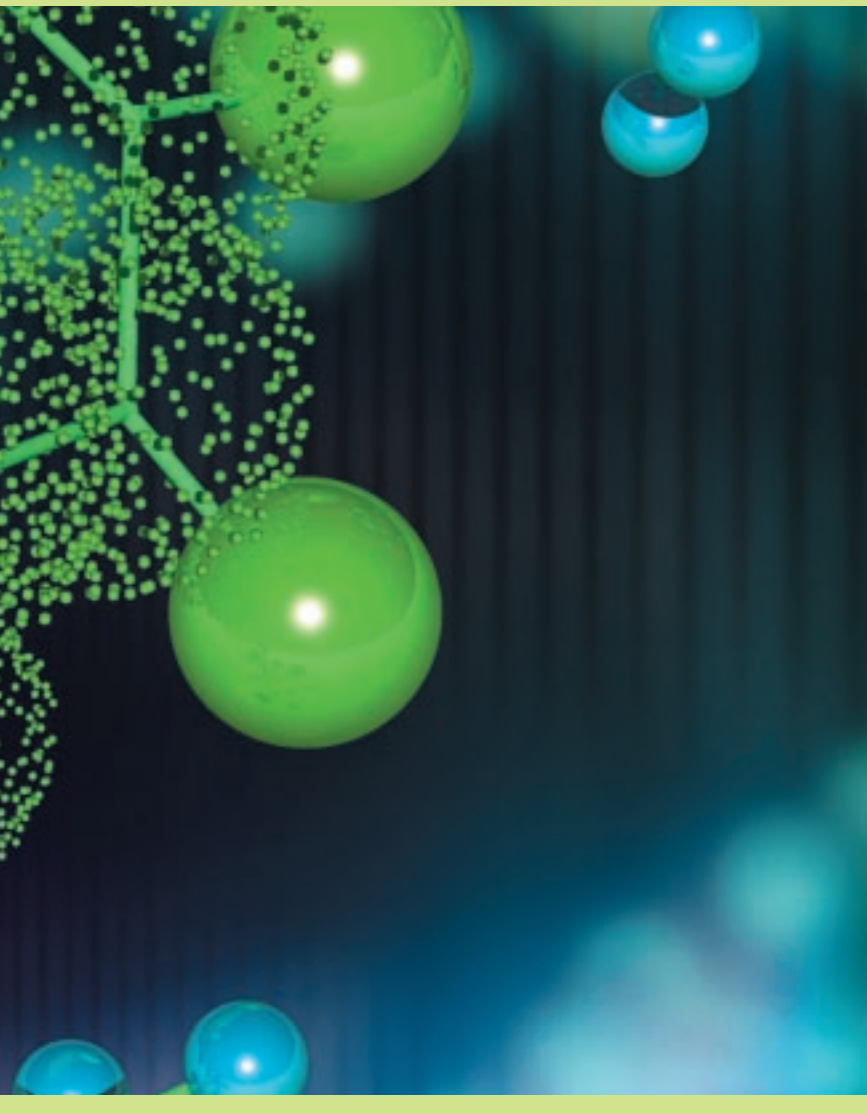
A Scottish scientist has identified an Achilles' heel in cancer cells which could signify a global change in cancer treatment, and her groundbreaking research could lead to new treatment for particularly aggressive forms of the disease.

University of Dundee scientist, Dr Barbara Spruce, has discovered a way of triggering cancer cells to self-destruct selectively without harming normal cells.

"The essence of our discovery is that cancer cells, through their selfish will to survive, have inadvertently burdened themselves with a vulnerability - an Achilles' heel - whose sole means of protection seems to involve a pathway linked to opioids," Dr Spruce explains. "When we switch off this protective pathway, the apoptotic self-destruct mechanism is unleashed in the cancer cells. But importantly, normal cells can tolerate this with no noticeable ill-effects."

The pioneering approach works by unleashing the process known as apoptosis, a natural self-defence mechanism which causes damaged cells to self-destruct. It is a defect in this process that contributes to most cancers and the goal of much current cancer research is to restore apoptosis in cancer cells without causing healthy cells to self-destruct at the same time.

Dr Spruce's research focuses on the sigma receptor, a molecule expressed by tumour cells and which causes them to resist the natural suicide programme. In effect, the sigma receptor is a natural shield against the self-destruct mechanism of apoptosis. The particular class of drugs being researched by Dr Spruce and her team switch off the function of the sigma receptor, effectively dismantling the protective shield and unleashing natural self-destruction.



As well as being administered alone, the drugs can be used in combination with conventional therapies such as chemotherapy and radiotherapy, and evidence shows that this enhances the effect of the traditional treatment without enhancing the side effects. Significantly, because the new drug allows the traditional therapy to be administered in smaller, less toxic doses, the overall side effects of treatment are actually lessened.

Tests on Dr Spruce's work bear out earlier evidence that the drugs may be particularly effective in treating tumours that don't respond well to traditional therapies. If the new treatment can be said to attack cancer's Achilles' heel, it appears that the more aggressive the tumour, the greater its potential susceptibility to the new treatment. In recognition of her pioneering research, Dr Spruce was named winner of the inaugural Royal Society of Edinburgh Gannochy Trust Innovation Award in June 2003. At the awards dinner held at Scone Palace near Perth, Dr Spruce was presented with a gold medal and a cheque for £50,000 (approximately \$92,000).

"What is vital about this award," explained Dr Spruce "is that the prize money will help us to take the next crucial steps towards testing these drugs in patients with cancer."

Since receiving the award, support from the National Cancer Institute and their framework of scientists and institutes across the United States is helping to accelerate the process of taking Dr Spruce's research from bench to bedside. Some results are already patented and available from the UK Patent Office. Scientific publication is imminent and a journal reference will be added to the Science Scotland website as soon as it is available.

In the meantime, Dr Spruce continues the work she started nearly two decades ago when she was a practising endocrinologist. "At the time I was combining science with practising as a doctor but I became increasingly drawn to the science," says Dr Spruce. Cancer patients of the future may have cause to be glad of that.

Dr Barbara Spruce is currently Scottish Enterprise Tayside Commercialisation Fellow in the Department of Surgery and Oncology in the Medical School at Ninewells Hospital in Dundee.

The Gannochy Trust is Scotland's second largest charitable trust. The Gannochy Trust Award is given annually to a young innovator whose work has the potential to promote social and economic well-being.

The Royal Society of Edinburgh is Scotland's National Academy for Science and the Arts. Founded in 1783, it is one of the oldest National Academies in the world.

National Cancer Institute
www.cancer.gov.uk
Patent Office www.patent.gov.uk
University of Dundee www.dundee.ac.uk

Record Growth Anticipated for Scottish Biotech

Another multi million pound contract boosts Scotland's booming biotech industry and confirms Japan's appetite for Scottish scientific research.

A recent £4.5 million deal between Glasgow-based Scottish Biomedical and Japanese drugs giant Kyorin is the latest in a string of successful collaborations between innovative Scottish science and Japanese industry.

This is one of many successes applauded by Scotland's Deputy First Minister, Jim Wallace, on a visit to the Far East, where he announced that Scotland's biotechnology industry is growing at twice the pace of its European counterparts.

Speaking at a meeting with Fujisawa Pharmaceuticals and Mitsubishi Pharma, both of whom have joint research projects with Scottish universities, Mr Wallace said: "Scotland's biotechnology sector is growing at almost twice the pace of the industry in the rest of Europe - 28% compared to 15% elsewhere."

The latest figures, published on February 12th 2004 in a Scottish Enterprise Report, show the trend continuing, with growth at more than 20% in each of the last 2 years. Scotland's biotech industry now has over 515 organisations employing more than 26,500 people and with Edinburgh picked as the destination for the BioEquity Europe Conference in May 2004, Scotland looks set to strengthen its position at the heart of global biotechnology.



Scottish Enterprise's Framework for Action Report (2004) can be obtained from www.scottish-enterprise.com

BioEquity Europe Conference www.biocentury.com

Next Generation Robots Display a Gentle Touch

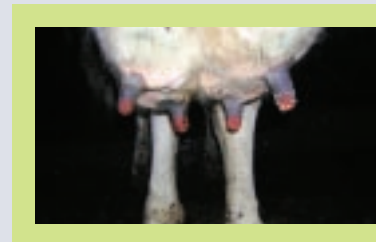
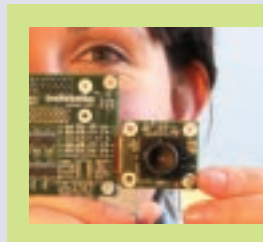
A Scottish firm has combined stereo vision and biomimetic innovation to create a new breed of service robots that are flexible enough for complex tasks in the real world.

Image Fusion Systems Ltd (IFS) had developed a human eye tracker for use in telepresence systems for robotic surgery. Meanwhile, Intelligent Compliant Engineering Ltd (ICE) was working on a biomimetic continuum robot actuator for use in dairy farm automation.

"ICE actuators needed guidance and control, while IFS wanted something to guide and control," explains IceRobotics' chairman, Bruce Davies, who began exploring biomimetic robotics as a PhD student.

Last year the two firms merged to form IceRobotics, and the resulting flexible teat-seeking robotic arm, Teat Tracker™, is now well on its way to market.

Since the early 1990s, two thousand robotic milking machines have been introduced in farms worldwide. These first generation systems use laser-scanning technology to locate the cow's teat and guide a rigid robotic



arm to attach the milking cups. There is no doubt that the technology has increased yields but the robots are vulnerable to dust and dirt, the laser technology is expensive, and too much contact with the machine can damage the animal. In contrast, the Teat Tracker™ is less precise but gentler on the animal. Using stereoscopic CMOS cameras, the vision sensor can locate and map multiple teats to within a millimetre, sufficiently accurate for the compliant actuator to latch on and attach the milking cups.

Describing the actuator and its finger-like manipulators, commercial manager Robert Boyce explains: "It's like a human hand. It can deform itself according to the object, so you don't need such high accuracy when handling delicate items."

The result is a system rugged enough for the complex, unstructured and dirty settings of the real world, but one that is gentle enough to interact with humans and animals. IceRobotics plan to develop alternative uses for their innovative biomimetic technology and are looking into 3D imaging and display, face and hand gesture interpretation and robotic navigation systems.

In the meantime, they are busy building the first prototype mechanical robot system for the dairy farm industry after successfully securing £430,000 (US \$780,000) of investment.

Directory

The Scottish Parliament Public Information Service
The Scottish Parliament| Edinburgh EH99 1SP
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Textphone 0131 348 5415
Freephone 0845 2781999
E-mail sp.info@scottish.parliament.uk
www.scottish.parliament.uk

The main functions of the Scottish Parliament are: to hold the Scottish Executive to account by analysing its policies; to make laws on devolved matters by means of examining, amending and voting on Bills; to hold debates and conduct inquiries. The Parliament can also currently raise or lower the basic rate of income tax for Scottish taxpayers by up to 3 pence in the pound. The work of the Scottish Parliament is carried out via its members and committees, the most significant of which in terms of SET-related activities are: European and external relations, education, enterprise and culture, environment and rural development, health, and local government and transport.

The Scottish Executive
E-mail ceu@scotland.gsi.gov.uk
www.scotland.gov.uk

There are six departments within the Scottish Executive, covering Enterprise and Lifelong Learning; Health; Justice; Education; Development; and Environment and Rural Affairs. There are also separate finance and central services divisions. Many of the research-active agencies of the Executive are present within the Scottish Executive Environment and Rural Affairs Department SEERAD. Other Agencies include: the Scottish Prison Service, the Student Awards Agency for Scotland, and HM Inspectorate of Education.

Scottish Executive Enterprise and Lifelong Learning Department (SEELLD)
Enterprise and Lifelong Learning Department Secretariat, The Scottish Executive, 6th Floor, Meridian Court Cadogan Street, Glasgow G2 6AT
Tel 0141 248 4774 Fax 0141 242 5665
E-mail ceu@scotland.gov.uk
www.scotland.gov.uk/who/elld

SEELLD was formed out of the pre-devolution Scottish Office Education and Industry Department. SEELLD supports Scottish ministers' economic and industrial development, further and higher education, skills and lifelong learning plans and objectives.

Innovation Support

Innovation Support SEELLD runs a number of innovation support grant schemes to help SMEs to develop highly innovative products and processes to the benefit of the national economy. The SMART: SCOTLAND Award is a competition open to individuals planning to set up a business and existing businesses with fewer than 50 employees. The SPUR Programme is non-competitive and available to existing medium-sized businesses with between 50 and 249 employees. The SPURPLUS Programme supports SMEs developing world-class innovations in areas that usually require very expensive research. In addition, SEELLD supports lone inventors and innovative small firms through ICASS (Innovators Counselling and Advisory Service for Scotland) and is also responsible for the Scottish Executive's interests in a number of UK-wide innovation initiatives such as TCS, LINK, Faraday Partnerships, etc.

Enterprise Network

Economic and skills aims are promoted by SEELLD through sponsorship of Scottish Enterprise and Highlands and Islands Enterprise and via their networks of Local Enterprise Companies (LECs). LECs support business start-up and certain business services, support skills development including training programmes.

Energy and Telecommunications

While these are reserved matters, SEELLD does liaise with these sectors and with Whitehall to ensure that Scotland's interests are represented. The Department also provides advice to Scottish Executive ministers on devolved matters including the promotion of renewable energy, energy planning consents, energy efficiency and the roll-out of broadband services.

Scottish Funding Councils for Further and Higher Education
Scottish Higher Education Funding Council (SHEFC)
Donaldson House, 97 Haymarket Terrace
Edinburgh EH12 5HD
Tel 0131 313 6500
E-mail info@sfc.ac.uk www.shefc.ac.uk

SHEFC is an NDPB accountable to the Scottish Executive through SEELLD. It was established in 1992 to provide financial support for teaching, research and associated activities in Scottish higher education institutions and to assess the quality of higher education supported by SHEFC. There are currently 21 institutions funded by SHEFC (other arrangements are in place for the Scottish Agricultural College).

Scottish Further Education Funding Council (SFEFC)
Donaldson House, 97 Haymarket Terrace
Edinburgh EH12 5HD
Tel 0131 313 6500
E-mail info@sfc.ac.uk www.sfefc.ac.uk

SFEFC is an NDPB accountable to the Scottish Executive through SEELLD. Established in 1999, it distributes funds to the 46 further education colleges in Scotland. The Council offers guidance, disseminates good practice, and promotes innovation through its funding methods and special initiatives. It monitors the financial health of the sector and advises Scottish Ministers on its funding needs.

Scottish Qualifications Authority (SQA)
Hanover House, 24 Douglas Street
Glasgow G2 7NQ
Tel 0141 2422214 Fax 0141 2422244
E-mail helpdesk@sqa.org.uk
www.sqa.org.uk

The SQA, an NPDB of the Scottish Executive, is the national body in Scotland developing, accrediting, assessing, and certifying qualifications (excluding degrees). It is therefore responsible for developing and awarding most of the academic and vocational qualifications available in Scotland's schools, colleges and in the workplace. Each qualification is developed in partnership with education, industry and government and is recognised nationally and internationally.

Directory

Scottish Enterprise
5 Atlantic Quay, 150 Broomielaw Glasgow G2 8LU
Tel 0141 248 2700 Fax 0141 221 3217
www.scottish-enterprise.com

Funded by the Scottish Executive, Scottish Enterprise works with 12 local enterprise companies and the public and private sectors to make industries more competitive. The work includes help to start-up companies, assisting existing companies to grow, promoting and encouraging exporting, and skills development. Priorities include commercialisation of academic ideas into good business opportunities, e-business, globalisation and economic inclusion. A separate network exists for the Highlands and Islands of Scotland, Highlands and Islands Enterprise. Website: www.hie.co.uk. It delivers its programmes to create a strong, diverse and sustainable economy through ten local enterprise companies.

Scottish Development International
5 Atlantic Quay, 150 Broomielaw Glasgow G2 8LU
Tel 0141 228 2828 Fax 0141 228 2089
www.scottishdevelopmentinternational.com

Scottish Development International is a Government-funded organisation working to promote Scotland's key strengths in knowledge-based industries, high-level skills, technology and innovation. The main aims of SDI are: to create partnership investments between Scottish and other companies to open new channels to markets, technologies and products; increasing exports; helping to strike licensing deals between Scottish and overseas companies and universities; the attraction of direct investment, concentrating on research, design, and development projects with high knowledge content. SDI's key sectors are creative industries, electronics, software and e-business, forestry, food and drink, aerospace, financial services, contact centres and biotechnology. SDI has 21 overseas offices.

Scottish Executive Environment and Rural Affairs Department (SEERAD)
Environment and Rural Affairs Department
Secretariat, The Scottish Executive
Room 440, Pentland House, 47 Robbs Loan
Edinburgh EH14 1TY
Tel 0131 244 6023 Fax 0131 244 6116
E-mail ceu@scotland.gsi.gov.uk
www.scotland.gov.uk/who/dept_rural.asp

SEERAD deals with policy advice and implementation in the areas of: agriculture, rural development, food, the environment, and fisheries. It sponsors and promotes the Scottish agricultural and biological science base. Key areas are: sustainable development and economic performance of Scotland's agriculture, aquaculture, fishing and food industries. SEERAD also has responsibility for agricultural, food and fisheries industry performance related to the EC Common Agricultural Policy and Common Fisheries Policy legislation, plus work with plant diseases and pests, animal and fish diseases, and promotion of high animal welfare standards on farms and in transport. SEERAD Environment Group works on the development of policy across the broad range of activities including: pollution prevention and environmental protection, integrated pollution prevention and control, water environment, drinking water quality, waste management, air quality, radioactive waste, noise, climate change and ozone depleting substances, wildlife and nature conservation, biodiversity, countryside and national parks. The group is responsible for the sponsorship of several external agencies, regulatory bodies or statutory advisers, i.e. the Scottish Environment Protection Agency, the Drinking Water Quality Regulator, the Water Industry Commissioner for Scotland (Economic Regulation), and Scottish Natural Heritage, plus two with service delivery functions: Scottish Water (responsible for water and sewerage service provision) and National Parks in Scotland. Additionally, SEERAD through ABRG, has responsibility for and funding commitments with a number of scientific research institutes in Scotland (though these bodies are also now seeking commercial contracts and (financial support). Several non-departmental public bodies are supported, including the Royal Botanic Garden, Edinburgh, the Crofters Commission, and the Deer Commission for Scotland.

SEERAD Agricultural and Biological Research Group (ABRG)
Room 434, Pentland House, 47 Robb's Loan
Edinburgh EH14 1TY
Tel 0131 244 6057 Fax 0131 244 6566
www.scotland.gsi.gov.uk

The ABRG funds a range of basic, strategic and applied research in the agricultural, biological, environmental and related life sciences. In commissioning research across the spectrum from basic and strategic research to more specific applied and policy-related research, ABRG has a role partly of a Research Council and partly of a 'customer' for research. The research programme forms a significant part of the UK science base. Research is conducted primarily through the five Scottish Agricultural and Biological Research Institutes (SABRIs), the Scottish Agricultural College (SAC), the Royal Botanic Garden Edinburgh (RBGE) and Biomathematics and Statistics Scotland (BioSS).

Hannah Research Institute
Ayr KA6 5HL
Tel 01292 674000 Fax 01292 674004
www.hri.sari.ac.uk

Founded in 1928, the Hannah Research Institute is an international scientific research centre focused on the biology of lactation and the use of milk in food products, though its research areas cover food technology and biological organisation from whole animals, through organs, tissues and cells, to the molecular levels.

Macaulay Institute
Craigiebuckler, Aberdeen AB15 8QH
Telephone 01224 498200
Fax 01224 311556
E-mail enq@macaulay.ac.uk
www.macaulay.ac.uk

In the decade or so before devolution, the Macaulay Institute focused on research supporting the agricultural industry and relevant Scottish Office departments, in light of UK and EC environmental objectives. The Institute is now the premier centre for sustainable land use research in Europe, concerned with rural economic and community development and the protection and enhancement of natural resources. Research at the Institute is multidisciplinary across soil, plant and animal science, geography, socio-economics and IT areas. Research staff perform integrated studies of physical, environmental, and social consequences of land use. Land managers and land use policy-makers in the UK and Europe are among the main customers of the Institute.

Directory

Moredun Research Institute (MRI)
Pentlands Science Park, Bush Loan
Midlothian EH26 0PZ, Scotland
Tel 0131 4455111 Fax 0131 4456111
www.mri.sari.ac.uk

Work at MRI is generally concerned with the health and welfare of farm animals. Established in 1920, MRI is internationally recognised for its work on infectious diseases of sheep and other animals. Research areas include innovative basic and strategic multidisciplinary research on diseases that undermine biological efficiency, impair animal welfare or threaten public health. MRI is also interested in furthering sustainable agriculture through its work on control and prevention of disease. MRI also maintains specialist diagnostic and disease surveillance services. The Institute is now a charitable company and a non-departmental public body, receiving core funding from SEERAD. Additional funding comes from national and international competitive awards and from commercially sponsored research via the Institute's affiliated company Moredun Scientific Ltd.

Rowett Research Institute
Greenburn Road, Bucksburn Aberdeen AB21 9SB
Tel 01224 712751 Fax 01224 715349
E-mail enquiries@rowett.ac.uk
www.rowett.ac.uk

Research at the Institute is split into four human and animal research divisions: appetite and energy balance; cellular integrity; development, growth and function; and gut microbiology and immunology. The Institute is driven by recognition of problems of over-nutrition being linked to certain diseases and changes and competition in agriculture. The Institute aims to define the role of nutrients in human and animal disease cause and prevention, and has an interest in sustainable methods of agriculture.

Scottish Crop Research Institute
Invergowrie, Dundee DD2 5DA
Telephone 01382 562731
Fax 01382 562426
www.scri.sari.ac.uk

The Institute has eight research programmes set out across three main themes, related to agricultural, horticultural and industrial crops - including genetic modification issues. Within its Understanding Mechanisms and Processes themes, the Institute is looking at gene expression, cell-to-cell communication, and plant-pathogen interactions. The Genes to Products theme looks at quality, health and nutrition, and at genome dynamics. Management of Genes and Organisms in the Environment covers ecosystem management and biotechnology, environmental interactions at the soil-plant interface, host-parasite co-evolution, and computational biology research.

Royal Botanic Garden Edinburgh
20A, Inverleith Row, Edinburgh EH3 5LR
Tel 0131 552 7171 Fax 0131 248 2901
www.rbge.org.uk

The Royal Botanic Garden Edinburgh is a scientific institution pursuing research on the systematics and biology of plants that underpin other plant science and conservation matters. The Garden has internationally significant collections of living and preserved plants, and one of the largest botanical libraries in the UK. It is also a centre for lifelong learning and a tourist attraction.

Biomathematics and Statistics Scotland (BioSS)
The University of Edinburgh,
James Clerk Maxwell Building,
The King's Buildings Edinburgh EH9 3JZ
Tel 0131 650 4900 Fax 0131 650 4901
www.bioss.ac.uk

BioSS works in the field of mathematics and statistics applied to the biological sciences, and contributes research, consultancy and training to agricultural, biological and environmental research organisations in Scotland. BioSS also collaborates in fundamental research, for instance with many UK universities. The BioSS staff includes a group of statisticians, mathematicians and computing experts located at the University of Edinburgh and across the five SABRIs that operate under SEERAD's Agricultural and Biological Research Group.

Scottish Agricultural College (SAC)
West Mains Road, Edinburgh EH9 3JG
Tel 0131 535 4000 Fax 0131 535 4246
E-mail information@ed.sac.ac.uk
www.sac.ac.uk

SAC has R&D resources, education and training provision, and expert advisory and consultancy services. Its research is mainly on agriculture and related sciences, rural business development and management, food chain quality and safety, and rural resource and environmental management. SAC has three main campuses, at Aberdeen, Ayr and Edinburgh, 23 local advisory offices, eight veterinary centres and five research farms. Research partners include: Government departments, academic and research bodies, and local authorities.

Fisheries Research Services (FRS)
E-mail enquires@marlab.ac.uk
www.marlab.ac.uk

FRS is an agency of the Scottish Executive. Its mission is to: 'provide science that is respected, relevant and responsive' to customers needs. The agency undertakes research and monitoring in order to provide advice, information and technical support to policy makers and a wider public. The principal scientific programmes cover aquaculture and animal health, fishery management, the aquatic environment and marine ecosystems. The Agency comprises two main laboratories; for marine issues (Aberdeen) and freshwater fish (Pitlochry).

Marine Laboratory
P.O. Box 101, 375 Victoria Road
Aberdeen AB11 9DB
Tel 01224 876544 Fax 01224 295511

Freshwater Laboratory
Faskally, Pitlochry, Perthshire PH16 5LB
Tel 01796 472060 Fax 01796 473523

Directory

Scottish Agricultural Science Agency (SASA)
82 Craigs Road, East Craigs Edinburgh EH12 8NJ
Tel 0131 244 8890 Fax 0131 244 8940
E-mail info@sasa.gsi.gov.uk
www.sasa.gov.uk

SASA incorporates a community of around a hundred scientists and support networks, based in Edinburgh. The work of SASA biologists and chemists ensures the quality, safety and security of the food supply in Scotland, and protects the quality of the environment, in areas that have been devolved to the Scottish Executive. In addition to protecting and diagnosing field and horticultural crops with regard to diseases and pests, SASA also acts as the Executive's Inspectorate of GM crops. Research is also underway on preserving and maintaining a wide range of historic, heritage and other varieties of potatoes, cereals, peas and brassicas. SASA monitors pesticide use and the pesticide load in the Scottish diet, and guards wildlife against deliberate or accidental environmental poisoning. Other areas of research activity include plant variety testing, seed potatoes, seed testing and certification, and ecological research on important vertebrate species (e.g. rabbits, foxes, geese).

Scottish Fisheries Protection Agency (SFPA)
Pentland House, 47 Robb's Loan
Edinburgh EH14 1TY
Tel 0131 244 6059 Fax 0131 244 6086
www.sfpa.gov.uk

The SFPA monitors industry's compliance with UK, EU and international fisheries laws and regulations in ports and at sea within British fisheries limits around Scotland and in international waters when required. In undertaking these tasks, it uses fishery patrol vessels and surveillance aircraft, with the shore-based operation being undertaken by the sea fisheries inspectorate, which is based at 18 ports round the Scottish coast. The SFPA is involved with enforcement policy and prosecution evidence in cases of non-compliance with various regulations.

Other bodies with SEERAD sponsorship
Scottish Environment Protection Agency (SEPA)
SEPA Corporate Office,
Erskine Court Castle Business Park,
Stirling FK9 4TR
Tel 01786 457700 Fax 01786 446885
www.sepa.org.uk

SEPA was formed in 1996 and assumed the water regulation and air pollution functions of local authorities, and the functions of Her Majesty's Industrial Pollution Inspectorate and the river purification authorities. SEPA is now responsible for the protection of the overall environment in Scotland, focusing on land, air and water, while working in partnership with others and towards a sustainable and diverse Scottish economy. SEPA also maintains a flood warning system, implements the National Waste Strategy, operates the Scottish part of the Radioactive Incident Monitoring Network, and works with the Health and Safety Executive regarding risks of major accidents at industrial sites.

Scottish Natural Heritage
12 Hope Terrace, Edinburgh EH9 2AS
Tel 0131 447 4784 Fax 0131 446 2277
E-mail www.enquiries@www.snh.gov.uk
www.snh.org.uk

The aim of Scottish Natural Heritage is to promote care of a sustainable Scottish natural environment. The organisation engages in policy development, advice, some research, and guidance to the Scottish Parliament. A Research and Technical Support Programme and Strategy is centred around the elements of the landscape, the physical and biological aspects of the natural heritage, including its natural beauty and amenity, and the interactions of all those elements with the people of Scotland. The structure of the organisation features three regional Advisory Boards and a Scientific Advisory Committee.

Scottish Water
PO Box 8855, Edinburgh EH10 6YQ
E-mail customer.service@scottishwater.co.uk
www.scottishwater.co.uk

Scottish Water provides water and wastewater services to household and business customers across Scotland (equal to around one third of the total land area of Britain). Scottish Water is public sector organisation directly answerable to the Scottish Parliament. SEERAD is the Scottish Executive Department with most direct sponsorship and control over Scottish Water.

Scottish Executive Health Department (SEHD)
Telephone 0131 244 2440
Fax 0131 244 2162
E-mail ceu@scotland.gov.uk
www.scotland.gov.uk/who/dept_health.asp

The Scottish Executive Health Department (SEHD) is responsible for health policy and the administration of the National Health Service in Scotland. SEHD also has responsibility for the State Hospital, which cares for patients who require treatment under conditions of special security, and for NHS Health Scotland, which promotes positive attitudes to health and encourages healthy lifestyles. Lastly, SEHD deals with social work policy, community care, and voluntary issues.

Other organisations
Roslin Institute
Roslin Biocentre, Midlothian EH25 9PS
Tel 0131 527 4200 Fax 0131 440 0434
www.roslin.ac.uk

The Roslin Institute is one of the eight research institutes in the UK sponsored by the BBSRC. It receives additional research funding from a variety of sources, including DEFRA, the Scottish Executive, the European Commission and industry. A leading centre for research on farm and other animals, Roslin has internationally recognised programmes on molecular and quantitative genetics, genomics, early development, reproduction, animal behaviour and welfare and has pioneered methods for the genetic modification and cloning of farm animals. In 1996, Roslin and collaborators PPL Therapeutics created Dolly the sheep, the first animal cloned from a cell taken from an adult animal.

Directory

Universities Scotland
53 Hanover Street, Edinburgh EH2 2PJ
Tel 0131 226 1111 Fax 0131 226 1100
E-mail info@universities-scotland.ac.uk
www.universities-scotland.ac.uk

Universities Scotland is the autonomous voice of the higher education sector in Scotland. It is a membership organisation, funded by the 21 Scottish universities and colleges of higher education in Scotland. It exists to promote the good work of its members, to argue for the public support needed to maintain and build on their achievements, and to develop policy on Scottish higher education issues. Until 2000, Universities Scotland was known as the Committee of Scottish Higher Education Principals (COSHEP).

Scottish Science Advisory Committee (SSAC)
22-26 George Street, Edinburgh EH2 2PQ
Tel 0131 2405014 Fax 0131 2405034
E-mail adavidson@scottishscience.org.uk
www.scottishscience.org.uk

The SSAC is a new and independent voice for Scottish science. It provides independent advice to Scottish Executive ministers on strategic scientific issues. The broadly based Committee is uniquely placed to take an overview of the broad and diverse scientific landscape in Scotland and to place this in an international perspective. It takes a medium to long term, horizon scanning and strategic view in formulating its advice on science strategy, science policies and science priorities with an overall aim of improving the social, environmental and economic prosperity of Scotland. The Committee's role is not to provide specialist scientific or technical advice, as ministers will continue to rely on the wide range of expert scientific committees that operate at both UK and EU level.

Universities

University of Aberdeen	Regent Walk ABERDEEN AB24 3FX T: 01224 272000 W: www.abdn.ac.uk
University of Abertay	Dundee Bell Street DUNDEE DD1 1HG T: 01382 308000 W: www.abertay.ac.uk
Bell College of Technology	Almada Street HAMILTON ML3 0JB T: 01698 283100 W: www.bell.ac.uk
University of Dundee	Perth Road DUNDEE DD1 4HN T: 01382 344000 W: www.dundee.ac.uk
University of Edinburgh	Old College South Bridge EDINBURGH EH8 9YL T: 0131650 1000 W: www.ed.ac.uk
Edinburgh College of Art	Lauriston Place EDINBURGH EH3 9DF T: 0131 2216000 W: www.eca.ac.uk
University of Glasgow	GLASGOW G12 8QQ T: 0141 339 8855 W: www.gla.ac.uk
Glasgow Caledonian University	70 Cowcaddens Road GLASGOW G4 0BA T: 0141 331 3000 W: www.gcal.ac.uk/home_dhtml.html
Glasgow School of Art	167 Renfrew Street GLASGOW G3 6RQ T: 0141 353 4500 W: www.gsa.ac.uk
Heriot-Watt University	Riccarton EDINBURGH EH14 4AS T: 0131 449 5111 W: www.hw.ac.uk
Napier University	219 Colinton Road EDINBURGH EH14 1DJ T: 0131 444 2266 W: www.napier.ac.uk
University of Paisley	High Street PAISLEY PA1 2BE T: 0141 848 3000 W: www.paisley.ac.uk
Queen Margaret University College	Clerwood Terrace EDINBURGH EH12 8TS T: 0131 317 3000 W: www.qmuc.ac.uk
Robert Gordon University	Schoolhill ABERDEEN AB10 1FR T: 01224 262000 W: www.rgu.ac.uk
Royal Scottish Academy of Music and Drama	100 Renfrew Street GLASGOW G2 3DB T: 0141 332 4101 W: www.rsamd.ac.uk
Scottish Agricultural College	The Kings Buildings West Mains Road EDINBURGH EH9 3JG T: 0131 535 4000 W: www.sac.ac.uk
University of St Andrews	St Andrews FIFE KY16 9AJ T: 01334 476 161 W: www.st-andrews.ac.uk
University of Stirling	STIRLING FK9 4LA T: 01786 473 171 W: www.stir.ac.uk
University of Strathclyde	GLASGOW G1 1XQ T: 0141 552 4400 W: www.strath.ac.uk
UHI Millennium Institute	Caledonia House, 63 Academy Street, INVERNESS IV1 1BB T: 01463 279000 W: www.uhi.ac.uk
Open University in Scotland	10 Drumsheugh Gardens EDINBURGH EH3 7QJ T: 0131 226 3851 W: www.open.ac.uk



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For more information about the Royal Society of Edinburgh and its work, please contact Stuart Brown at sbrown@royalsoced.org.uk Phone 0131 240 5000.

The Royal Society of Edinburgh,
22-26 George Street, Edinburgh, EH2 2PQ