

a need to develop alternative projects more suited to the majority of graduate's career paths. There is also currently considerable public interest in ethical issues in science. With the new "Twenty First Century Science" GCSE and AS/A2s in "Science and Society" and "Critical Thinking", ethics is increasing being incorporated within GCSE and A-Level science curricula. However, significant numbers of teachers do not have the confidence or knowledge to provide this teaching. The aim was therefore to develop alternative projects where students would develop and deliver "Science and Society" activities for local school children, evaluating and writing up this exercise as their final year research project.

A student was given the brief to develop a 2 hour interactive "Science and Society" session for Key Stage 5 pupils as part of the Leeds Festival of Science on the topic of "Animal experimentation, cruel or necessary?". No constraints were placed on the format of the session but it had to incorporate a means by which it could be evaluated. Background information on the topic was provided by two 10 minute presentations, one arguing for, the other against the use of animals in research before participants debated questions such as: "Do animals have rights. Are we abusing these when we undertake animal experiments?" and "45% of animals used have been "made in the lab"- genetically modified. Should we be making and using such animals?", firstly in small groups and then in a plenary session. Discussion within the groups was facilitated by student volunteers. A second session entitled "Playing God, the use and abuse of human genetic information" was also run for KS 4 students utilising a different format. Participants were provided with brief introductions to individual topics e.g. Eugenics or Designer babies; they were then given case studies to discuss, firstly in small groups and then in a plenary session. The sessions were evaluated using pre and post session questionnaires on ethical viewpoints, the use of personal response systems within the session and by end of session pupil and staff feedback questionnaires. Feedback from both school staff and pupils was extremely positive. Pupils knowledge of the topic and the underlying ethical issues was increased. They enjoyed the sessions and would return for additional sessions on other topics. The undergraduate students then wrote up this exercise as their final year research projects

These projects encourage students to be enterprising and innovative; they also enhance their future career opportunities and employability. By working with the local community and schools, not only are these students promote the public understanding of science, but also hopefully they will also encourage schoolchildren to follow them into science-based courses at Leeds.

P072

Animal models of disease and injury: a new *in vivo* based module for 2nd year students at King's College London

Lawrence Moon, Aileen King. *King's College, London, United Kingdom.*

"Animal models of disease and injury" is a new course for 2nd year undergraduate students at King's College, London. It aims to give students an understanding of *in vivo* research and provide hands-on *in vivo* experience prior to a year in industry or final year projects. The course covers lectures in animal models of various diseases, workshops in statistics and experimental design, and in ethics and the 3Rs, and *in vivo* practicals.

In the first year of the course 24 places were offered. 12 students were accepted on to the course based on first year results and a personal statement indicating why they were interested in doing the course. Seven of these students studied pharmacology, two studied pharmacology & molecular genetics and three studied biomedical sciences.

Students did their Home Office licence training the week before term started in September, allowing personal Home Office licences to be obtained before the course started in January. A teaching project licence was already in place. Four *in vivo* practicals were run during the course, two using mice and two using rats. Students wrote reports on each of the practicals in the format of a scientific article. In addition, an experimental design workshop was held where students wrote a report justifying the use of animals in the style of an ethics review application. The course is assessed on these five reports (50% of final mark) and on multiple choice questions in an end-of-year exam (50% of final mark).

After completing this course, three students will do an extramural year which will include *in vivo* work (25% of the students). 50% of the students chose to do a final year project and all these students included an *in vivo* project as one of their four preferred projects. Some of these students have also opted to do an *in vivo* summer project.

In summary, by the end of the course, 42% of the students had committed to projects involving their Home Office licence and depending on final year project allocations, up to 75% of students will use their Home Office licences within a year.

P073

The pedagogic value of *in vivo* practical classes: an example using glucose tolerance tests in lean and obese mice

Aileen King, Ian Kinchin. *King's College, London, United Kingdom.*

The use of animal models is an essential part of medical research and drug development. The essential skills required to be able to do such research includes experimental design, statistical analysis and the actual handling and treating of the animals (*in vivo* skills). The number of students in the U.K. receiving training in handling and experimenting on animals has declined rapidly in the last few decades which has led to initiatives to increase numbers of students with these skills to meet demand. We have recently started a new course for 2nd year undergraduates entitled "Animal models of disease and injury". This course not only covers the theoretical aspects of using animals in research, but also involves students obtaining personal home office licences and contains practical laboratory classes in which students get hands-on experience using animals. One of the laboratory classes we run is a glucose tolerance test in obese and lean mice. Due to its relative simplicity and the reliability of generation of results, this is an ideal *in vivo* practical for inexperienced students. Using this practical class as an example, we would like to argue in favour of such classes providing enhanced learning in the understanding of integrative physiology and pharmacology. Indeed when students were asked the question "Has the *in vivo* component of the course enhanced your learning and if so, in what way?" all students that responded (75% of the course) indicated that the *in vivo* component had enhanced their learning. For some students it was evident that the smaller class size which is required for *in vivo* practical classes helped their learning by having easier access to members of staff. Others explained that active learning helped them understand the topic better. It was also noted by students that doing an *in vivo* experiment themselves helped them understand experimental design better. In conclusion, *in vivo* practical classes can give 2nd year undergraduate students *in vivo* skills prior to an extramural year or a final year project but also enhances the learning experience of the student.

P075

Use of 'delegation of procedures' for undergraduate *in vivo* training and education: impact on hands on skills and student feedback

Emma Robinson. *University of Bristol, Bristol, United Kingdom.*

As part of our final year undergraduate Pharmacology course, a selected number of students (10-15/year) are provided with a one-week *in vivo* training course. For the majority of years, students undertook Home Office Module 1-4 training and held a Home Office personal licence (PIL). Due to cost and timetabling issues, the sustainability of the course was in doubt. Following discussion with the Home Office Inspector, the replacement of a PIL with 'delegation of procedures' was implemented. There is a detailed list of what procedures can be delegated and the majority of our hands on practicals were suitable for this approach. The impact of replacing the personal licence with delegation of procedures on costs and hands on skills and course feedback is discussed.

The course coordinator provides theoretical material on the law, ethics, 3Rs, husbandry, welfare and experiment design. Students are provided with hands on practical skills using cadavers (mouse and rat), including dosing techniques, tracheotomy, blood vessel cannulation and a full anatomical dissection. For terminal anaesthesia experiments, the preparation is set up as a demonstration by a PIL holder and students administer the drugs for the experiment via the previously implanted cannula and record and analyse the data. For behavioural studies, dosing for the experiment is undertaken by a PIL holder and the students undertake the behavioural testing and analyse the data. To reduce the number of animals used, animals from the behavioural experiments are used for Schedule 1 methods and provide the cadavers for skills training. Despite not holding a PIL, the students gain a wide range of practical skills including handling and restraint techniques, dosing methods, surgical procedures and Schedule 1 methods through this combination of experimental work and cadaver sessions. The replacement of PIL with delegation of procedures significantly reduces the cost of the provision of *in vivo* training and education

This study investigates the HPA-axis following peripherally (HPA-activation) or centrally (neuroinflammation) administered LPS in C57Bl/6 male mice (ca. 11 weeks old). The presence of mRNA for V1b in the brain from untreated mice (n=6) was evaluated using *in situ* hybridisation (ISH) with diverse ³²P labelled antisense probes. The brain and pituitary gland were then collected (0, 2, 4, 8 and 24h) after induction of different acute inflammatory stressors administered either peripherally (LPS, 500µg/kg i.p., n=6) or centrally (LPS, 50µg/kg i.c.v., n=6) and TaqMan® Real-Time RT-PCR for V1b, with β-actin β-microglobulin and GAPDH as housekeeping genes for normalisation was performed. Untreated and saline treated (2.5 ml/kg, i.p. or 50µl/kg, i.c.v.) control animals were studied in parallel. Evaluation of the brain using ISH showed a strong signal for V1b mRNA in the hippocampus only on coronal brain sections from untreated mice (n=6) following ISH. No changes in V1b were seen in the hypothalamus or pituitary gland 2-24h after i.p. administration of LPS. By contrast, peripheral administration of LPS caused significant decrease in V1b mRNA in the hippocampus after 2h (23%, p<0.05) compared with time-matched saline controls. Following i.c.v. administration of LPS there were no changes in the expression of mRNA for V1b in the hypothalamus or pituitary at any time point, but a small increase in the hippocampus after 2h only (22%, p<0.05) vs. time-matched saline controls.

This study supports data that AVP plays a key role in the release of ACTH after chronic stress, as no changes in mRNA in pituitary gland were seen post acute stressor. Thus, this novel data suggests that AVP plays an important role within the hippocampus following different acute inflammatory stressors administered locally or centrally. The up-regulation or down-regulation observed indicates a degree of plasticity within the hippocampus in response to different stressors. This should be substantiated with further investigations that could perhaps utilise the emerging antagonists for this receptor.

- ¹ G Guillon *et al.*, *J Neuroendocrinol.* 2004 Apr; 16(4):356-61.
² T Shimazaki *et al.*, *Eur J Pharmacol.* 2006 Aug 14; 543(1-3):63-7.
³ W Jing *et al.*, *Neurosci Lett.* 2009 Feb 6; 450(3):306-10.

P068

Modelling the nasopharyngeal carriage of streptococcus pyogenes in the mouse

Faraz Alam, Shiranee Sriskandan, Siouxsie Wiles. *Imperial College, London, United Kingdom.*

Streptococcus pyogenes is responsible for the deaths of over 500,000 people every year, and is the cause of morbidity in a further 15 million. This pathogen causes many disease manifestations, such as streptococcal pharyngitis, scarlet fever, necrotizing fasciitis and acute rheumatic fever. These manifestations of streptococcal disease have been correlated to asymptomatic nasopharyngeal carriage, however almost all murine models for this infectious agent result in the death of the animals within a few days. The creation of a refined mouse model for streptococcal nasopharyngeal carriage will therefore enable a better understanding of the factors underlying streptococcal infection, and allow for more efficient screening of potential vaccines. We have pioneered new dosing and sampling strategies and tested multiple different isolates in order to determine the most appropriate conditions development of an asymptomatic nasopharyngeal carriage for *S. pyogenes*.

P069

The British Pharmacological Society (BPS) Integrative Pharmacology Fund

Mike Collis.
BPS, London, UK.

In vivo integrative studies using animals are essential in translating information from the genome into advances in understanding of human and animal disease and in developing the next generation of drugs. Surveys have shown that there has been a significant erosion of the training opportunities for integrative physiologists, pharmacologists and toxicologists in the UK. The bleak outlook for *in vivo* training, in the UK led to the formation of the British Pharmacological Society Integrative Pharmacology fund (IPF) in 2004. AstraZeneca, GlaxoSmithKline and Pfizer donated £4 million to the BPS to support high quality *in vivo* research and training in UK universities. Since its formation, the IPF has supported *in vivo* teaching courses such as the BPS/Physiological Society summer courses, worked with the BBSRC, MRC and CRUK to co-fund *in vivo* PhD research students and with RCUK to support academic fellows. It has collaborated with BBSRC, MRC, HEFC, SFC and the DIUS to provide Capacity Building Awards in Integrative Mammalian Biology (IMB) to six UK universities.

These awards are to support and sustain a core of institutions in the UK with the highest quality research and teaching expertise in *in vivo* integrative pharmacology, physiology and toxicology, and with a long-term commitment to support an exemplary culture of animal welfare. The IMB awards are funding new staff appointments, PhD and MRes studentships and new training courses. The £4 million originally donated to the IPF by the pharmaceutical industry has now catalysed the provision of over £20 million for *in vivo* research and training including support for 24 new academic staff, over 150 PhD studentships and >500 undergraduate training places. This is an important start to re-building the integrative *in vivo* expertise base that underpins Biomedical Research in the UK.

P070

Animal welfare, ethics and the 3Rs: teaching materials, best practice and ideas for training provision from across the UK

Dave Lewis^{1,2}, Terry McAndrew^{1,3}. ¹University of Leeds, Leeds, United Kingdom, ²IDEA CETL, Leeds, United Kingdom, ³HEA Centre for Bioscience, Leeds, United Kingdom.

The Bioscience Federation and ABPI report "*In-vivo* sciences in the UK: sustaining the supply of skills in the 21st Century" highlighted the need for future *in-vivo* scientists to be provided with training in animal welfare, ethics and the 3Rs. To provide maximum benefit to animal welfare, it is essential that this training is provided as early as possible within an individual's career and that providers work together to share best practice and teaching materials. Given the nature and extent of training in animal welfare and ethics within UK undergraduate and postgraduate degree programmes is unknown, the aims of this project were to survey provision, to gather best practice and teaching materials and to disseminate this information.

Online surveys were utilised to determine the nature and extent of undergraduate and postgraduate student exposure to animals or animal tissues within different degree programmes, the training in animal welfare, ethics and UK law provided, and to ascertain what training Staff thought should be provided. Undergraduate surveys were distributed to the Heads of all UK Life Sciences, Biology and Psychology Departments via Learned Society, HEA Psychology and Centre for Bioscience email distribution lists. The postgraduate survey was sent to all Directors of Graduate Schools or Postgraduate Research Training and via Home Office Liaison Officers, Named Veterinary Surgeon and Home Office email distribution lists. Respondents were also asked to identify examples of good practice and materials within their teaching. 57 and 24 responses were obtained from the UG and PG survey respectively. For postgraduates, the key findings were the lack of training in experimental design, statistical design and harm/benefit analyses, limited use of debates on the use of animals in research or knowledge of alternatives. There was also limited training in the ethics and law for postgraduate Schedule 1 users. In contrast, there was increased provision of training in these areas within undergraduate degree programmes, with the exception of harm/benefit analyses and the debating of the use of animals in research.

Examples of best practice included structured discussion sessions to teach ethics and law to undergraduate students who use isolated tissues in their studies, using role-play in debates to provide "Science and Society" training in the arguments for and against animal experimentation for both undergraduate and postgraduate students, using case studies to provide training in the workings of ethical review committees for personal licence holders and to get these students to reflect on their application of the 3Rs within their own research.

The implementation of the findings of this study, particularly the adoption of the identified best practice and teaching materials in training, should result in significant improvements to animal welfare nationally.

P071

Animal experimentation, cruel or necessary? Developing and delivering science and society activities as alternative final year undergraduate research projects

Dave Lewis^{1,2}. ¹University of Leeds, Leeds, United Kingdom, ²IDEA CETL, Leeds, United Kingdom.

Budgetary, staff and space constraints means that there is an increasing impetus for Life Sciences Departments to develop alternatives to traditional laboratory-based wet research projects for their final year undergraduate students. Less than 20% of these graduates go onto science-based careers, there is therefore