muscle signalling proteins, p-mTOR (mammalian target of rapamyosin), p-S6 kinase and calpastatin, were measured by Western blot.

Between 130 and 144 days of gestation, the prepartum cortisol surge was associated with significant reductions in the protein levels of p-mTOR, p-S6 kinase and calpastatin in fetal skeletal muscle (Table 1). In the cortisol-infused fetuses, p-mTOR and p-S6 kinase levels were significantly lower than those infused with saline (Table 1). When values from all fetuses were considered, significant inverse relationships were observed between plasma cortisol and p-mTOR ($r=-0.46$, $n=20$, $p<0.05$), p-S6 kinase ($r=-0.63$, $n=20$, $p<0.05$) and calpastatin ($r=-0.48$, $n=20$, $p<0.05$). Therefore, in fetal sheep, the growth-retarding actions of cortisol may be mediated, in part, by suppression of anabolic signalling proteins, such as p-mTOR and p-S6 kinase, in skeletal muscle.

Table 1. Mean (±SEM) concentrations of plasma cortisol and muscle signalling proteins in the fetuses of each experimental group. Within each column, values with different superscripts are significantly different from each other ($p<0.05$, one-way ANOVA and Tukey test). Au, arbitrary units.

Treatment group	Gestational age (days)	Plasma cortisol (ng/ml)	p-mTOR (au)	p-S6 kinase (au)	Calpastatin (au)
Untreated and saline-infused (n=8)	130	13.2 ± 1.6^{A}	1.00 ± 0.09^{A}	1.00 ± 0.06^{A}	1.00 ± 0.08^{A}
Untreated (n=7)	144	86.7 ± 17.3^{B}	0.47 ± 0.09^{B}	0.55 ± 0.11^{B}	0.64 ± 0.05^{B}
Cortisol-infused (n=5)	130	91.2 ± 20.9^{B}	0.61 ± 0.03^{B}	0.48 ± 0.04^{B}	0.84 ± 0.11^{AB}

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Authors have confirmed where relevant, that experiments on animals and man were conducted in accordance with national and/or local ethical requirements.

C32

Effect of maternal diet and body condition on glucose metabolism and skeletal muscle structure in mature adult sheep offspring

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Early life nutrition is implicated in the risk of metabolic diseases (e.g. type 2 diabetes) in adulthood. Low birth-weight was associated with defects in the skeletal muscle insulin-signalling pathway of young adult men (1), and insulin resistance was associated with changes in myofibre composition (2). In sheep, maternal undernutrition reduced fetal skeletal muscle myofibre density and composition (3). Recently we reported that lower body condition score (BCS) led to increased fasting glycaemia, mild glucose intolerance and impaired initial insulin secretory response in adult offspring (4). We hypothesised that this would worsen with age, and that altered skeletal muscle structure and insulin signalling pathways are involved.

Ewes were established, by dietary manipulation, at a BCS of 2 (lower (L) n = 10) or >3 (higher (H) n = 14) before and during pregnancy (4). In male offspring at 4.04±0.02 years plasma glucose and insulin concentrations were measured during a glucose tolerance test (0.5 g/kg body weight *i.v.*) and rams were killed by an overdose of barbiturate (*i.v.* 145 mg/kg). We analysed a) insulin-signalling proteins by Western blotting in abdominal fat and vastus muscle (*m.*); b) glucose uptake in isolated strips of vastus and soleus *m.*(5); c) myofibre density and cross-sectional area (CSA) by immunostaining with anti-fast skeletal myosin (3). Data are mean±SE and were analysed by Student's t test.

Glucose tolerance was similar between groups. Basal glucose uptake was similar in L and H group soleus and vastus *m.* isolated strips. However insulin-stimulated uptake tended to be reduced in the soleus *m.* only of L rams (H 1.01±0.06; L 0.84±0.07 pmol.min.mg, $p<0.1$). In vastus, but not soleus, *m.* total myofibre density (H 343±15; L 294±14 fibres/mm^2, $p<0.05$) and fast myofibre density (H 226±10; L 194±10 fibres/mm^2, $p<0.05$) was lower in L rams. Slow myofibre density tended to be lower in L rams (H 117±7; L 100±6 fibres/mm^2, $p<0.1$). Myofibre CSA was unaltered. Protein levels of (i) Akt1 were lower in the vastus *m.* (L=83±7% of H, $p<0.05$), and tended to be lower in abdominal fat (L=71±7% of H, $p<0.1$), of L rams; (ii) GLUT-4 were increased (L=157±6% of H, $p<0.001$), and (iii) IGF-IR tended to be reduced (L=78±12% of H, $p<0.1$), in the vastus *m.* of L rams.

Reduced signalling through Akt1 may therefore mediate the decreased vastus *m.* myofibre density in L rams resulting in reduced glucose tolerance of the young adult offspring (4). However in mature adulthood, glucose tolerance and glucose uptake into vastus *m.* was not altered by maternal BCS, and thus the impact of reduced myofibre density may be offset in part by increased GLUT-4. Such adaptations may lead to complications in metabolic control in an overabundant postnatal nutrient environment.

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Authors have confirmed where relevant, that experiments on animals and man were conducted in accordance with national and/or local ethical requirements.

C33

A controlled trial evaluating the effectiveness of the Human Patient Simulator as an educational tool for teaching respiratory physiology

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We have previously reported (Lloyd et al., 2006) that use of the Human Patient Simulator (HPS; METI, Florida) can enhance traditional approaches to teaching physiology. HPS scenarios are popular with students (Euliano, 2001) but randomised controlled trials (e.g. Wong et al., 2007) have failed to demonstrate

significant improvement in academic performance following exposure to HPS-based physiology teaching compared with other teaching methods. This study evaluates the effectiveness of the HPS as an educational tool for teaching respiratory physiology, in comparison with tutorial teaching.
First year dental undergraduates were allocated to attend either a tutorial (control group; n = 34) or the HPS session (HPS group; n = 36). All students completed the same written MCQ test under examination conditions two weeks before (pre-teaching test; pre-TT), and then immediately after the teaching session (post-TT). The test required interpretation of data such as arterial oxygen saturation, respiratory rate and partial pressures of blood gases. All test papers were marked electronically.
Students in the control group had 30-min of private study to work through respiratory data interpretation and True-False questions. The answers were then discussed in a 1-hr tutorial (in groups of 10 students) with the students' regular tutors, all of whom were experienced teachers. The HPS group received a 1-hr respiratory simulation session (in groups of ca. 20 students) led by an experienced HPS teacher followed by 15-min private study to analyse the simulated data. This was followed by a staff-led, 15-min review session. All students then completed the post-TT.
To ensure equality of opportunity, all students attended the other format of teaching after completion of the post-TT.
Test scores were expressed as a percentage of the maximum mark obtainable averaged for each group of students ± SEM. There was no significant difference between the pre-TT scores for the two groups ($p = 0.24$, unpaired t-test). There was a significant increase in performance of the HPS group (post-TT mean score 53.7 ± 3.0 vs. pre-TT mean score 40.3 ± 2.8; $p = 0.0006$, paired t-test). There was also an improvement in performance of the control group (post-TT mean score 51.5 ± 3.6 vs. pre-TT mean score 44.6 ± 2.4), however this did not reach statistical significance ($p = 0.07$, paired t-test).
We conclude that the respiratory HPS session was more effective than the tutorial in improving students' academic performance.

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Authors have confirmed where relevant, that experiments on animals and man were conducted in accordance with national and/or local ethical requirements.

C34

Effectiveness of problem based learning (a Case Study)

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Problem based learning (PBL) has been used as a means of teaching Medicine students since it was introduced in the early 70's by McMaster University's Faculty of Medicine as a revolutionary approach to Medical Education. Typically, in problem-based learning, students use triggers from problem cases or clinical scenarios to prompt learning and define learning outcomes. To provide a context for learning, PBL uses appropriate problems within small groups to increase knowledge and understanding. Presentation of clinical material as the stimulus for learning enables students to understand the relevance of underlying basic science knowledge and principles in clinical practice (Wood, 2003). In addition to the acquisition of knowledge in context, exponents claim that PBL enhances other desirable skills such as teamwork, problem solving, communication skills, independent learning and working within a team (Allen *et al*, 1996). In meta-analysis, PBL courses garnered significantly greater praise in student program evaluations than traditional curricula (Vernon & Blake, 1993).
The aim of this study was to investigate the effectiveness of PBL as taught to students of a third year clinical Student Selected Component entitled "Creaking Hinges – The Functional and Clinical Anatomy of the Synovial Joint". This course applies basic life science teaching to clinical scenarios and so is an ideal platform for PBL. A questionnaire rating the effectiveness of the PBL encountered on the course was administered to the students at its conclusion. Questions focused on the purported advantages (putting knowledge in context, fostering communication skills, encouraging team work and self directed learning) and common criticisms (giving students problems without the information needed to solve them) of the PBL format. A 5 point Likert scale was used to evaluate the student response to each of the questions with 1 indicating strong disagreement with a statement and 5 strong agreement. 12 out of 13 student participants in the module responded (92.3% student response rate). Ratings are given as marks out of 5 ± S.E.M, n =13.
Students gave high ratings to the PBL course format in areas of clinical reasoning, 3.7±0.2, problem solving 4.2±0.2, communication skills 4.1±0.2, and team work 3.8±0.3. Lower ratings were given, however, to the ability of a PBL course to impart basic knowledge 2.8±0.3. These initial results would indicate that a hybrid PBL/traditional course for students is optimal, with a more traditional course during the early years of medical education segueing to a more context-driven PBL course after the basic information has been imparted. This would be particularly true for mature students, or those from a non-traditional academic background coming into courses such as Nursing.

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Authors have confirmed where relevant, that experiments on animals and man were conducted in accordance with national and/or local ethical requirements.

C35

Effect of podcasts and mobile assessment on student performance in a final year undergraduate biomedical sciences module

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Higher education students increasingly expect their lecturers to supplement traditional forms of teaching with 'blended learning' approaches, including video lectures, podcasts, online quizzes etc. Indeed, HEFCE and the UK Government's E-learning strategy encourage academics to use such tools in their teaching. In particular, a number of US and UK institutions have begun to publish podcasts of lectures for students, but studies show no effect (positive or negative) of providing podcasts on examination performance. The aim of this study was to combine podcasts of extracts of lectures with mobile assessments (via SMS on mobile phones) to evaluate the effect on examination performance. Students (n=100) on a final year, research-led, module on brain and behaviour were randomly divided into control (n=50) and trial (n=50) groups. The trial group were given access to podcasts / mobile formative assessments for fourteen lectures on the module. The control group were not able to access the resources. Towards the end of the module, all students on the module completed a formative MCQ assessment (under examination conditions) on the material in the fourteen lectures. Following this assessment, the control group were given access to the podcasts / mobile assessments for revision purposes. Students in the trial group who listened to podcasts of the lectures and completed mobile assessments (n=31) performed significantly better in the formative assessment (58.1±1, mean±S.E.M; P<0.05, Student's T-Test) than other students in the group (52.2 ± 2; n=54). Students accessed the podcasts via iTunes (or similar software; 38%), from the institutional virtual learning environment (31%), or using a combination of the two (31%). Interestingly, only around 21% of students listened to the majority of their podcasts away from a computer. The results of this study indicate that providing supporting resources does have a positive impact on student performance.

Centre for Bioscience, Higher Education Academy

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C36

Use of innovative online self- and peer-review software to allow undergraduate students additional practice at short answer exam questions in human physiology

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Human Form and Function (HFF) is a Level 2 (year 2 of a 4 year BSc(Hons) degree) undergraduate module offered by the School of Life Sciences Learning and Teaching, University of Dundee. This 11 week module serves as an introduction to human physiology, with lectures (33) and lab-based practicals (4) covering the major physiological systems which complement a self-directed study component in anatomy and histology. Class size is 160 and includes students registered for a number of Life Sciences degrees (e.g. Physiological Sciences, Forensic Anthropology and Biomedical Sciences). Although in-course assessment grades have been good, students do not perform as well in the end of module written exam. Here we report the use of innovative software (devised in-house by The Learning Centre, University of Dundee) designed to easily create and automatically manage online self- and peer-review assignments. We have used this software to allow HFF students additional practice at answering exam-style short answer questions (SAQs).

The self- and peer-assessment software is embedded within the existing module virtual learning environment, so is easily accessed and familiar to students. Students were first asked to prepare answers to two SAQs (covering cardiovascular and respiratory physiology; 15 marks each) and upload these answers during a submission phase. At the end of the submission phase, model answers and a marking scheme to the set SAQs were made available and the software automatically allocated each student the answers of two anonymised peers to mark along with their own submission. As well as providing marks for each question, students had the opportunity to leave feedback comments which were available to view at the end of the marking phase. At the end of the exercise students were able to view average self and peer marks and anonymised feedback. Finally, they were then invited to complete an online feedback questionnaire covering aspects of the exercise.

Student participation in both the submission and marking phases was excellent (89% and 83%, respectively), comparable to other compulsory in-course assessments. Although there was a slight difference (P=0.003, two-tailed unpaired t-test) between mean (±SEM) self (21.2±0.4, n=132) and peer marks (19.6±0.4, n=133), there was no significant difference (P=0.382) between mean marks awarded by peer 1 (18.3±0.6, n=133) and peer 2 (17.5±0.7, n=133). Response to the online feedback questionnaire was good (49% of the class completed the questionnaire) and feedback outcome was most positive (mean response out of a maximum of 10 (±SEM)=7.39±0.13, n=25 questions). Overall, this has proved a popular learning exercise with this cohort of students. It was easy to implement and manage and has obvious time-saving benefits to comparable hand-marked assessments.

Authors have confirmed where relevant, that experiments on animals and man were conducted in accordance with national and/or local ethical requirements.

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PC45

Using a human patient simulator to demonstrate the autonomic control of the cardiovascular system

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The METI Human Patient Simulator (HPS) is a state-of-the-art, life-sized, high fidelity mannequin linked to a computer through a host of electro-mechanical equipment. This integration of software-driven electro-mechanics allows the modelling of a wide range of physiological and pharmacological states. The data from the HPS is projected in the format of a clinical monitor and includes heart rate, systolic and diastolic arterial pressures and cardiac output. Drugs can 'interact' with the underlying HPS model via predefined pharmacokinetic and pharmacodynamic parameters.
In this study we describe the development of an HPS session integrating pharmacology and physiology in order to demonstrate sympathetic and parasympathetic control of the cardiovascular system.
A 30 minute HPS scenario for around 20 students is integrated into the existing first year MBChB and second year BSc practical classes in cardiovascular pharmacology. The students, using their knowledge of the cardiovascular system have to predict the effects of various drugs (phenylephrine, propranolol, atropine and dobutamine) that act to influence the parasympathetic and sympathetic nervous system on heart rate, blood pressure and systemic vascular resistance. The students then give i.v. administrations by 'injecting' the drugs into the HPS using a drug recognition system that detects different drugs using a barcode reader. Under the guidance of a member of staff the students discuss the responses obtained from the HPS. The students also learn about the tonic control of the heart by the autonomic nervous system via chemical denervation using atropine and propranolol.
The effects of the drug dosages 'given' to the HPS on the cardiovascular parameters correlate well with published human data (Atropine and propranolol for intrinsic heart rate[1], phenylephrine[2], atropine[3], propranolol[4], and dobutamine[5].)
The session was rated highly by students with 85% (n= 164) scoring the value at 4 or above (scale of 1-5, 5 being very well), when responding to the question how well did the HPS session help you understand the control of blood pressure? The students also thought the session helped improve their understanding of the clinical relevance of drugs acting on the CVS with 78% of students (n= 164) scoring the value of this session at 4 or above (scale of 1-5, 5 being very well).
We conclude that this HPS session enhances the current physiology and pharmacology student learning experience and gives accurate qualitative physiological changes to the drugs administered.

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PC46

The response to hypoxia: a comparison of the Human Patient Simulator (HPS) with human data

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The Human Patient Simulator (HPS 337; METI, Sarasota, Florida) has a computer driven mechanical lung and gas exchange mechanism, designed to model the human respiratory system. We have previously demonstrated that the HPS is a useful tool for illustrating physiological principles but requires adjustments to the modeling software in order to improve the fidelity of the quantitative response to perturbations such as simulated hypovolaemia [1].
The aim of this study was to compare the response of the HPS to hypoxia with available human data in order to determine the accuracy of the HPS response and the utility of the HPS for teaching high altitude human physiology. Data can be obtained from the HPS for a range of respiratory variables including breathing rate, tidal volume, simulated alveolar and arterial partial pressures of oxygen and carbon dioxide, and arterial oxygen saturation.
The simulator was intubated and baseline measurements were made of the respiratory variables including the partial pressures of oxygen and carbon dioxide in alveolar (PAO_2 and $PACO_2$) gas whilst "breathing" atmospheric air at ambient pressure. The responses were then determined to breathing hypoxic gas mixtures (range = 19–5% O_2) applied using Douglas bags and a three-way valve system to separate inspired and expired gases. The data were used to construct an Oxygen-Carbon Dioxide diagram for comparison with published human data [2,3,4].
In response to hypoxia the HPS showed a linear relationship between PAO_2 and $PACO_2$ over the entire range investigated (PAO_2 = 25-110 mmHg; n = 6). Published human data for unacclimatised individuals shows a linear relationship between PAO_2 and $PACO_2$ over a PAO_2 range of 60-100 mmHg but below this

range there is a non-linear relationship [2,3]. This is due to hyperventilation resulting in a respiratory alkalosis when PAO_2 decreases below approximately 60mmHg [2].The HPS failed to exhibit appropriate degrees of respiratory alkalosis in response to PAO_2 below 60 mmHg, equivalent to breathing atmospheric air at an altitude of around 2500m (8500ft) and a barometric pressure of 550 mmHg [approximated values derived from 5] We conclude that the HPS is a useful tool for demonstrating trends in the physiological response to changes in the environment, in this case hypoxia, but that the model requires some adjustment in order to more accurately represent human data and demonstrate high altitude physiology.

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Authors have confirmed where relevant, that experiments on animals and man were conducted in accordance with national and/or local ethical requirements.

PC47

Use of a high fidelity Human Patient Simulator to demonstrate the control of ventilation

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The Human Patient Simulator (HPS; METI, Florida) is a high fidelity, life-sized, computer-controlled manikin that includes a mechanical lung and simulated gas exchange mechanisms. It models a range of physiological variables and we have previously described (Lloyd et al, 2006) how it can be used to enhance cardiovascular teaching. The present study describes how the HPS can also be used to good effect in demonstrating the importance of blood gases in controlling ventilation.

The scenario we have developed extends and enhances our existing respiratory physiology practical classes in which students use spirometers, vitalographs, Haldane tubes and pulse oximeters to study their own respiratory function. The HPS provides a real-time numerical display of simulated respiratory variables such as arterial and alveolar partial pressures of oxygen and carbon dioxide, arterial oxygen saturation, respiratory rate and tidal volume. The HPS scenario is delivered to groups of ca. 20 students who record the simulated data on worksheets and also observe physical signs such as the manikin's depth and frequency of breathing. The manikin is intubated and baseline data for breathing room air are recorded. Responses to the following interventions are then recorded:

a)breathing 90% nitrogen and 10% oxygen (to provide a hypoxic stimulus);
b)breathing 95% oxygen and 5% carbon dioxide (to provide a hyperoxic and hypercapnic stimulus);
c)breathing 100% nitrogen;
d)increasing dead space by attaching a length of tubing to the endotracheal tube;
e)neuromuscular blockade;
f)bag-valve-mask external ventilation.

The teaching is delivered in a problem-solving format, facilitated by a member of staff. Students are required to identify the composition of each gas mixture (a – c) by observing the simulated respiratory responses, and to predict the outcome of the other interventions. The scenario therefore provides a vivid and memorable illustration of the nature and rapid time course of the ventilatory responses to changes in arterial gases. Student feedback for the scenario is very positive with 83% of a cohort of 250 second year medical students reporting that it was helpful in increasing their understanding of the control of ventilation.

During development of the scenario we established that there is good correspondence between the simulated responses to breathing gas mixtures compared to published human data (e.g. Padget, 1928).

We conclude that the HPS is an engaging and effective educational tool for teaching respiratory physiology.

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PC48

The Virtual Frog; two computer-based practical classes for teaching neuromuscular physiology

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Practical classes featuring isolated frog nerve, and nerve-muscle preparations, used to feature heavily in the traditional teaching of neuromuscular physiology to physiology and medical science undergraduates. For a variety of reasons such classes using animal material are becoming more difficult to include in modern curricula.

The Virtual Frog classes consist of recordings made from frog (*Rana temporaria*) isolated sciatic nerve and gastrocnemius muscle preparations during undergraduate practical classes held in 1992. The tissue responses were digitised and recorded in computer data files. These data have subsequently been used to

allow students to reconstruct the experiments on standard laboratory PCs. This provides students with the experience of handling real recordings (not mathematical simulations), including noise and biological variation, but without the problems associated with using actual animal tissue.
Each program contains an introduction to the equipment and experimental arrangements, before a selection of experiments on that tissue is presented. On selection of an experiment the appropriate data records are displayed on a simulated oscilloscope, and the experimental parameters (eg stimulus voltage or muscle length) can be changed using drop down menus. On-screen cursors can be used to measure times and amplitudes from the displayed waveform.
Students are provided with detailed schedules containing spaces into which they are required to enter their measurements, plot graphs and answer questions. These sheets are completed during the course of the practical session, and are subsequently used in an in-depth group de-briefing session with a tutor to reinforce an understanding of the underlying physiological principals.
The experiments included in the two programs are:
Frog Sciatic Nerve – Gastrocnemius Muscle preparation –
Effect of stimulus intensity on twitch amplitude
Paired stimuli
Genesis of tetanus
Twitch length-tension plot
Effect of temperature changes on the muscle twitch
Effect of curare on the muscle twitch
Frog Sciatic Nerve preparation –
Effect of stimulus intensity on compound action potential amplitude
Paired stimuli and refractory period
Measurement of conduction times
Direction of conduction
Effect of temperature changes on the compound action potential.
These programs have been used in undergraduate physiology classes for more than 12 years. They have been well received by the students, enhance their understanding of neuromuscular physiology, and avoid the difficulties associated with providing classes involving animal tissues.

The development of these programs was supported by a grants from the Humane Research Trust and the AECC.

Authors have confirmed where relevant, that experiments on animals and man were conducted in accordance with national and/or local ethical requirements.

PC49

Critical reviews of biomedical documentaries in the media

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The development of the ability to critically evaluate scientific information is one of the core intellectual skills identified in the benchmark statements for the Biosciences (QAA, 2007) and for Medicine (QAA, 2002) and as such, it features as one of the explicit objectives of almost all undergraduate programmes in the life sciences. One common approach to developing and evaluating this skill is through exercises involving training in reading and presenting critical reviews of research papers.
This type of exercise is of considerable value in developing the students' critical skills and their ways of thinking about science and its underpinning through the evidence base (Rangachari & Mierson, 1995). However, these approaches do have limitations in that the research paper is a very stylised format, aimed at addressing a relatively small and very well-defined audience. As a consequence, the skills acquired may not be perceived as being immediately transferable to other contexts. A complementary approach, that has proved effective, has been to give students the task of evaluating scientific news stories presented in the media (Rangachira, 2006). In a development of this exercise, students are charged with producing a critical review of a biomedical television documentary. Students are allocated to groups of four and each group is given a DVD of a documentary, recorded under the Off-Air Recording (OAR) licence. A library of such recordings has been built up through weekly scanning of programme listings via the Television and Radio Index for Learning and Teaching (TRILT, www.trilt.ac.uk). The students' brief is to produce a presentation evaluating the documentary, focussing on its scientific content and the quality of presentation. Content is divided into the following elements: a synopsis of the subject matter, evaluation of the accuracy and currency of the material, the objectivity of the programme and its basis on underpinning evidence. The quality of the programme is evaluated in terms of clarity and delivery, quality of the visual elements and effectiveness in targeting the audience. This exercise requires careful critical evaluation of the material but also addresses other key skills including presentation and team working. An important additional feature is that, in order to be able to evaluate the scientific content effectively, the students have to research the topic in considerable depth. Feedback from the students has been very positive, in particular in terms of how interesting they found the exercise and the process of researching a new topic in a different context, and, for many, the novel experience of thinking critically about a scientific documentary programme.

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PC50

Evaluation of the effectiveness of the virtual microscope in teaching histology to veterinary students

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At the University of Bristol histology is taught alongside physiology. Histology has traditionally been taught in practical classes using light microscopes (LM) and glass microscope slides of tissue specimens. As part of the 'The Applied & Integrated

Medical Sciences Centre for Excellence in Teaching & Learning (AIMS CETL)' we have developed a virtual microscope (VM) using digital scans of our collection of histological specimens. Users are able to navigate around the virtual slides at a range of magnifications on networked computers using a software application 'Digital Slide Box' (Slidepath,Dublin).
The VM was introduced for the teaching of histology to first year veterinary science students in 2006-07 when it was used in 3 histology classes. In 2007-08 the VM was used in all 12 classes. To evaluate the effectiveness of histology teaching to veterinary students using the VM, we are undertaking a number of studies. We report here the findings from two such studies.
1) In April 2007 students undertook a formative histology examination that they knew to be in the same format as the end of unit histology examination. This consisted of three slides, with ten questions per slide. One of the slides was a section of bone that the students had studied using the LM. This same slide and questions were part of a formative 'midsessional test' for a new cohort of first year students in December 2007 who had studied the section using the VM. Using cohort analysis, the examination scores achieved following instruction using the LM or VM, were compared. The class score improved significantly from a mean mark of 29% in April 2007 (n=103, SD=18.5%) to 59% in Dec 2007 (n=106, SD=18.9%) ($p<0.0001$, unpaired t-test). More data from exam questions will be available in June 2008.
2) A study to test the student's learning experience using the VM vs LM was undertaken in January 2008. A tutorial was delivered to the students on the fundamentals of renal pathology using pathological renal tissue. Following the tutorial students were divided into groups. Two groups investigated the tissue further using either the VM or LM, the third was a control group and used neither. The student's prior and post tutorial knowledge was tested. Students then had the opportunity of using both the VM and LM and completed a questionnaire of their experience of the LM and VM. The results of the tests showed a significant increase in the scores post tutorial but showed no significant difference between the three groups of students. Results of the student questionnaire showed that the students prefer the VM as a learning tool and do not perceive any difference in image quality between the LM and VM.
In summary, first year veterinary science students prefer the VM over the LM to study histology. Preliminary data from formative examinations suggest the VM is a more effective learning tool.

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PC51

The use of video and audio pod files to support undergraduate lectures and laboratory classes in physiology

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Podcasting is gaining in popularity in the broadcasting world as a means of allowing people to view or listen to their entertainment at a time and place that suits them. Similarly, on-demand access to digital media has potential benefits for academia, especially in terms of matching the pace of learning to individual student needs.
We initially produced and podcasted short, scripted audio files covering material taught to undergraduate students taking human physiology modules. This approach was very popular with the students; their only 'complaint' was that they wanted more. We then extended this approach to producing short video files of 2-4 mins exploring a particular aspect or principle in physiology or human anatomy. The audio files were designed to accompany a handout with diagrams, but the video files allowed the audio and visuals to be combined.
Initially, video files on a particular topic were made available before the lecture covering that topic. No handouts were produced and students were instructed to view the files and take preliminary notes before attending the appropriate lecture and taking supplementary notes. This approach allowed more time to expound on principles during the lecture rather than covering the fundamental facts and information contained in the audio/video files. Despite dire warnings from colleagues that the students would either not attend lectures or not view the files, we found that students continued to attend lectures and did indeed use the digital materials produced to support them.
In the next stage of development, we decided to make the files unavailable for download as this could compromise IPR and lead to redistribution and alteration (eg via You Tube). We therefore developed a password-controlled resource in which the audio and video files were available for on-screen viewing only. The resource also allowed students to provide written feedback and provided usage-tracking at the level of the individual student. Because the files are not podcasted in the strict technical sense, we refer to them as 'pod' files rather than 'podcasts'. Though 2-4 min duration may not seem very long, it matches well the average duration of video snippets young people are exposed to (music videos and You Tube files); so, a particular topic may consist of up to 30 pod files. The resource also allows the author and user to organize the files on a public or private basis to share with other users.
We have also applied this approach to guiding students through practical laboratory classes, to assisting them on placement and with employability skills, peer assessment, and to providing higher skills training within industry. Examples of our video material will be demonstrated as will the resource for delivering the learning materials.

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PC52

Introduction of "Active Sessions" into the multi-focussed approach to teaching physiology to students lacking a science background

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The Year 1 Physiology for Nurses course at Manchester uses a combination of didactic teaching and investigation of clinical

scenarios using enquiry-based learning (EBL). However, a significant proportion of the 250 students enrolled do not possess an A-level in Biology (38% in 2007/2008). Teaching physiology to a mixed ability cohort of students is a challenging task as they lack the fundamental concepts. The EBL approach improved student's overall confidence and engagement in the subject area (Gouldsborough & Sheader 2006) and to further support these students, novel "active sessions" were introduced in September 2007.

Active sessions were delivered on a weekly basis to 250 students in a lecture theatre environment. Different physiology based activities, e.g. bingo, crosswords, happy families; were designed to allow students to consolidate their knowledge of the topic area covered during the preceding week, assess their understanding and identify their areas of weakness. This study aims to examine staff and student perceptions of the "active sessions" and their efficacy in the multi-focussed approach to teaching physiology to first year nurses.

Of the 145 respondents, the majority (59%) of students enjoyed the active sessions and 94% found they highlighted areas of weakness. 79 % felt that the active sessions integrated well within the multi-focussed approach to course delivery, supporting the notion that students valued the active sessions as they encouraged participation and forced them to take responsibility for their learning. 78% also felt that they had a good understanding of physiology on completion of the course. In addition, staff observed that these active sessions provided a balanced non-threatening environment for students to engage and learn physiological concepts.

This multi-focussed approach could be adapted to teaching physiology to other student groups lacking a scientific background or those requiring additional support.

Gouldsborough, I, Sheader EA (2006) Improving the EBL Experience for First-year Nurses. Case-Studies 2005-6 CEEBL supported projects. University of Manchester CEEBL. pp 125-145.

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PC53

Incisive observations: bringing back dissection for first-year science students

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In November 2007, a new practical class was introduced into NST 1A Physiology of Organisms, the comparative physiology course on offer to first year Natural Science students at Cambridge. This involved the detailed dissection of a rat and a trout, a classical anatomy practical of a kind that has been missing from the Natural Science curriculum for some years. The animals were obtained as frozen corpses: the rats were ex-experimental animals from the Department of PDN, whereas the trout were by-products of local angling competitions. The students dissected either species (their choice), using a photographic dissection guide designed by the author as a PowerPoint presentation. The three-hour class focussed in particular on respiratory, cardiovascular and digestive systems. Among the suggested tasks, students dissecting the rat were encouraged to inflate the collapsed lungs using a syringe and inject the heart with white latex solution to show up the aortic arch; those dissecting the trout used latex injections to help them identify the afferent and efferent branchial arteries, and they also looked at the gill apparatus and swim-bladder. During the class, the students made sketches of their dissections, and answered simple questions about how the anatomy relates to the physiology that they had learned.

There was initially some scepticism about whether Natural Science students (as opposed to veterinary/medical students) would be prepared to participate in a dissection class. In the event, we received no complaints at all about the use of animals: the students strongly approved of the "ethical" sourcing of specimens. About two-thirds of the class elected to dissect rats; the few students who were squeamish about dissecting mammals were happy to tackle the trout instead. Some even came back voluntarily to the next (repeat) class, to dissect the other species! The student feedback relating to our practical classes that term was the best that we have had for at least five years, with many students singling out the dissection class for special praise. At a time when fewer students have the opportunity to perform classical dissections at school, the inclusion of this inexpensive practical within a first-year University physiology course is particularly valuable in allowing students to see, in many cases for the first time, the structures and systems which they have been learning about.

Thanks go to the Department of Physiology, Development & Neuroscience for supporting this project, to the PDN Animal Facility and John Mees of Grafham Water for the kind provision of specimens, and to the technical staff without whom none of this would have been possible.

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PC54

An alternative to 'traditional' practical class teaching: debates

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Debates were introduced to 4th year Pharmacy students with an aim to discuss and critically analyse topics that were current and aligned with the lecture content. Students chose their own groups via 'sign-up' sheets which were made available on-line. The groups were then informed of their debate topic (but not their position in the debate), to allow adequate time for research (over a 3 week period). On the day of the debate, team positions were decided (affirmative or negative, debating or

reserve), with time given for students to finalise their arguments before commencing the debate. The debates were peer-assessed based on the following criteria: believability/credibility of the argument, scientific value, strength of rebuttal, presentation. Following the debates, students were asked to submit an on-line 'contribution sheet' detailing the participation of the group members. An on-line survey revealed that intended outcomes such as acknowledgment of diverse viewpoints, critical analysis of the topic areas, and self-perceived improvements in communication skills were reached. Student feedback revealed three major concerns; the equity of the debate topics, the equity of the team positions (1st speaker vs. reserve, affirmative vs. negative) and the allocation of marks (peer-assessment and contribution sheets). Overall, the debates appeared to be a positive teaching and learning approach, providing an alternative, yet relevant and effective manner with which to examine pharmacological issues.

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PC55

Introduction of on-line pre-practical quizzes as a means to increase undergraduate student engagement with laboratory practical classes

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Laboratory practical classes are a compulsory component of our physiology level 1 unit which is taken by approximately 180 students. The unit is mandatory for honours physiology and neuroscience undergraduates and is an optional unit for degree programmes, including biochemistry, anatomical science, psychology and biological science. We have observed that many students attend practical laboratories having not read the practical schedule and make little attempt to engage. A major theme of our 'Applied and Integrated Medical Sciences Centre for Excellence in Teaching and Learning (AIMS CETL)' is laboratory-based learning. To tackle this problem we adopted the thesis of (Bull and Stephens 1999), that assessment drives learning, and introduced a series of mandatory on-line quizzes which students were required to take in the week before each laboratory practical. Students were required to have an overall pass mark (40%) for the quizzes throughout the year to be deemed to have satisfactorily completed the required elements of the unit.

There were eleven quizzes in total, the first two were not associated with specific laboratory practicals but focussed on experimental design, data analysis and problem solving. The remaining nine quizzes were each associated with a particular laboratory practical, for example, haemolysis of blood, blood pressure, lung volumes and renal function. Students received emails reminding them of approaching quiz deadlines. Each quiz contained a variety of question types; numeric and text entry, multiple-choice, true-false and drag-and-drop. Upon completion of each quiz, a student was provided an immediate on-screen score and the opportunity to review feedback on each question they answered incorrectly. The quizzes were authored in Questionmark Perception (version 4) and are available for guest access at http://qmp.bris.ac.uk; username '1abc', password, '2xyz'.

Compliance was excellent; 75% of the students completed all 11 of the quizzes and of the maximum number of quizzes (180*11=1925), 1839 (95%) were completed. The distribution of marks was not normal but was right skewed, the median mark being 76%. Only two out of 180 students failed to achieve the required 40% overall pass mark for the quizzes.

Solicited, anonymous feedback from students was very positive with 78 comments volunteering that the quizzes obliged them to 'do preparatory work in advance of the practical', 'read the practical schedule' and 'practice relevant calculations'. One student wrote, "[the quizzes] did encourage me to read the schedule before the experiment when otherwise I won't have, in all honesty".

Bull, J. and D. Stephens (1999). Inn. Edu. Train. Int. 36(2): 128-136.

We gratefully acknowledge the help and advice of Roberta Perli, Learning Technology Support Service.

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PC56

On-line histology quizzes on a virtual microscope

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At the University of Bristol histology is taught alongside physiology and has traditionally been taught in practical classes using light microscopes (LM) and glass microscope slides of tissue specimens. As part of the 'The Applied and Integrated Medical Sciences Centre for Excellence in Teaching and Learning (AIMS CETL)' we have developed a virtual microscope (VM) using digital scans of our collection of histological specimens. Users are able to navigate around the virtual slides at a range of magnifications on networked computers using a software application, 'Digital Slide Box' (Slidepath, Dublin).

On-line VM quizzes were used extensively with the 2nd Year BVSc students in 2007-2008, as formative exercises, revising topics from the previous class, and also in a summative histology exam. Quizzes are built around annotations, with students entering answers into a drop-down form. Several histological slides can be included in a quiz, via a 'narrative' feature, and multimedia content can be associated with the slides or set to become visible on quiz completion. The correct answers can be revealed on individual submission or, if required, withheld until completion by a student group. Different student groups access course-specific areas within Digital Slidebox, so content can be tailored.

Quiz design is already flexible and major extensions and improvements are imminent. At present, questions can be in the format 'which one of the annotated items corresponds to

histological feature X?' where 'X' could be a cell type, or histological region; alternatively, the format can be 'the characteristics of histological feature X are...' where students must choose from a list of options. This latter format makes it easy to incorporate questions on function, and it has been helpful to design quizzes in conjunction with lecturers on relevant topics. This helps ensure the integration of histology with physiology and anatomy.
In the 2nd Year BVSc exam, a three-slide quiz was adapted by replacing a drop-down form with optical marking sheets. This is a conservative option, as the scoring/analysis features of the software are still under development. The ease of transition to optical marking demonstrates the flexibility of the quizzes as an assessment vehicle. Student feedback on the quizzes was extremely positive. For example, >95% of students rated the quizzes 'excellent' or 'good' in terms of usefulness both as a learning tool and as a revision aid.
In summary, students regard on-line quizzes, facilitated by Digital Slidebox, as a highly useful learning tool and revision aid.
Guest access to a demonstration on-line quiz is available at: http://137.222.11.10
Please login as a New User using the activation key 'psdemo'.

We gratefully acknowledge the technical support of Debbie Martin, Debi Ford, Graeme Cappi, Mally McLane, Peter Dickens and Paul Buttner.

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PC57

Dietary regulation of bovine ruminal UT-B urea transporter expression

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Ruminants, such as cattle, need to recycle nitrogen through the process of urea nitrogen salvaging (UNS) in order to maintain nitrogen balance (1). The process of UNS requires large amounts of urea to pass into the gastrointestinal tract and previous studies have suggested that this occurs through ruminal facilitative UT-B urea transporters (2). In this study we have investigated the effect of dietary intake on bovine ruminal UT-B urea transporter expression.
Ruminal tissue samples were obtained from 6 adult cows, 3 which had been fed an ordinary forage diet (RO) and 3 which had been fed a concentrate diet (RC). Using a ^{32}P-labelled full-length bUT-B cDNA probe, northern analysis detected no difference in the level of the 3.7kb bUT-B transcript between ruminal RNA samples from the two diets (NS, Unpaired T-Test). In contrast, western analysis of ruminal protein samples using a recently characterized bUT-B antibody detected significant differences between the two groups. For example, a 36 kDa bUT-B signal representing unglycosylated bUT-B2 was significantly greater in RC compared to RO ruminal protein ($P<0.05$, Unpaired T-test). Finally, using 10μM sections of methanol-fixed ruminal tissue, immunolocalization studies showed that while the bUT-B signal was found predominantly in the stratum basale in RO samples, it was found mainly within cells of the stratum granulosum in RC samples.
Our results therefore provide strong evidence that ruminal UT-B urea transporter protein expression is altered by dietary intake. Since ruminal microflora, short-chain fatty acids and pH are altered by concentrate feeding, further work on these factors are required to understand the cellular basis of UT-B expression.

Stewart GS and Smith, CP (2005) Nutr. Res. Rev. 18, 49-62.

Stewart GS, Graham C, Cattell S, Smith TPL, Smith CP and Simmons NL (2005) AJP Regul Integr Comp Physiol 289: R605-R612

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PC58

Exploration of the biochemical processes in rat gastric mucosa under the experimental ulceration

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World statistics says that stomach ulcer is still one of the most common diseases in the many European countries. On the cell level an important role in ulcer development play violations in the system of the biochemical processes. The aim of this study was to explore biochemical processes in the cells of the stomach gastric mucosa in rats under different models of experimental ulceration.
Wistar rats 150 grams weight were used in the experiment. The research were carried out using the aspirin (acetate), stress and ethanol methods of experimental ulceration. To induce stressful ulceration we used social immobilizing stress (Groisman, Carevina). Ethanol ulceration was induced by administration of 1 ml of 80% ethanol per os. To induce acetate ulceration we administered aspirin in doze of 150 microliters per kilogram of body weight 5 times a day during 3 days.
A complex exploration of the state of the plasma membranes of rat gastric mucosal cells under different models of ulceration was carried out. It was proven, that lipid peroxidation (LPO) processes play key role in ulcer development irrespective from the factors of ulceration. Under all explored conditions, the LPO products content in the homogenate of gastric mucosa was increased, while an activity of antioxidant enzymes was decreased. A decreased content of all groups of phospholipids was found in plasma membrane fraction. The most significant changes were found under stress – in 2 times. Cholesterol content was increased under stress and ethanol more than in 2 times. Decreased activity of membrane-associated enzymes was also found under ethanol and stress: Na-K ATPase, 5' nucleotidase, (in 1.8 times under ethanol, in 1.5 times under