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.

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".

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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'.

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.

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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

secretion by movement, halving qHA in moved joints (p=<0.001, paired t test, n=10). U73122 did not significant inhibit qHA in static joints (p=0.13, n=5, paired t test).

The study showed for the first time that the coupling between joint usage and HA secretion reported in (2) is a graded one, and that PLC may be an obligatory step in the signal transduction pathway. Ca^{2+} store release, PKC activation and downstream MEK-ERK can stimulate HA secretion in vivo, as in vitro; but whereas the PKC-MEK-ERK pathway mediates the response to stretch in vitro, it did not mediate the response to movement in vivo. Further elucidation of the signalling pathways is needed, with potential therapeutic implications.

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PC93

Commonly used loading controls in Western Blot studies are not suitable for use in post-natal rat skeletal muscles

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Western blot analysis is a widely used method for the semi-quantitative determination of the concentration of specific proteins in a tissue. To control and correct for equal protein loading error, a protein with relatively constant expression in the tissue is normally used as an internal loading control. In most studies the two main proteins commonly used are actin and α-glycerophosphate dehydrogenase (α-GAPDH) (Dittmer and Dittmer, 2006). However, in contrast to other proteins actin is too abundant in skeletal muscle and α-GAPDH is known to vary with fibre type. Therefore, the primary aim of this study was to investigate whether actin, β-tubulin and α-GAPDH are suitable loading controls for differentiating rat skeletal muscles. The experiments were performed using the extensor digitorum longus (edl, a mainly fast-twitch muscle in adult rats) and the soleus (a predominantly slow-twitch muscle in adult rats) muscles of Wistar rats aged between 1 and 90 days. The rats were killed by CO_2 inhalation and the EDL and soleus muscles from both hind limbs were dissected and rapidly snap-frozen in liquid nitrogen. Proteins were then extracted using NP40 cell lysis buffer. Equal amounts of protein (~10 μg per lane) were then resolved in a 10% polyacrylamide/sodium dodecyl sulphate gel. The proteins were then identified using monoclonal antibodies raised against β-tubulin, actin and α-GAPDH and analysed using Scion Image from NIH. The results show that the concentrations of all three proteins increase with age and that this is most rapid between the age of 1 and 14 days. Thereafter, the concentrations of actin and β-tubulin tended to remain relatively constant and were basically similar in the edl and soleus. On the other hand, the concentration of α-GAPDH was always higher in the edl than in the soleus at all of the ages examined. From these results we suggest that actin, β-tubulin

and α-GAPDH are not suitable loading controls for skeletal muscles isolated from animals younger than 14 days.

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PC94

L-Carnitine supplementation attenuates intermittent hypoxia-induced oxidative stress and delays muscle fatigue in rats

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The concept of L-carnitine supplementation to improve muscular performance is based on the role of L-carnitine in the rate limiting step of β-oxidation of fatty acids (1). L-carnitine attenuates free radical induced oxidative stress during recovery after exercise stress (2) and in pathological conditions (3). Thus it was hypothesized that L-carnitine may reduce intermittent hypoxia induced oxidative stress and thereby delays muscle fatigue. Thirty-six adult male Sprague Dawley rats were divided in two batches and each comprising three groups (n=6/group)-unexposed control; intermittent hypoxia exposed (6 hrs/day for continuous 7 days), intermittent hypoxia exposed (6 hrs/day for continuous 7 days) with L-carnitine supplementation (100mg/kg body weight/ day for 7 days). After the completions of exposure in batch I, rats were anaesthetized with ketamine (50 mg/kg bw, i.p.) and xylazine (10mg/kg bw, i.p.) and sacrificed. The thiobarbituric acid reactive substances, protein carbonyl and lipid hydroperoxides were estimated in the muscle tissue to investigate the efficacy of carnitine in attenuating oxidative stress. In batch II experiment, rats were anaesthetized with intramuscular dose of ketamine (50mg/kg bw). The gastrocnemius muscle of right hind limb with intact sciatic nerve was dissected with the Achilles tendon and connected to a force transducer. The gastrocnemius muscle was set at a length which produced an optimal force during each tetanic contraction. Electrical stimulation was used to induce six tetanic muscular contractions in gastrocnemius muscle after completion of exposure. Percentages of mean performed work, time of decay to 50% of peak force of contraction, and peak force of contraction were measured during tetanic contractions using high-speed data acquisition system. Mean frequency during recovery between tetanic contractions was measured from electromyography. Muscle damage was indirectly measured from plasma creatine kinase and lipid hydroperoxides. Significant reduction in thiobarbituric acid reactive substances, protein carbonyl, lipid hydroperoxides, and creatine kinase activity in L-carnitine supplemented-intermittent hypoxia exposed group when compared with placebo treated-intermittent hypoxia exposed group suggests that L-carnitine reduces oxidative damage and thereby delays muscular fatigue, which was further evident from improvement in maximum force of tetanic contraction, time of decay to 50% of peak force of tetanic contraction

and mean frequency of contraction during muscle recovery between tetanic stimulation in L-carnitine supplemented-intermittent hypoxia exposed group as compared to unsupplemented and exposed group of rats. From these results it is concluded that L-carnitine delays skeletal muscle fatigue in rats by reducing free radical induced oxidative damage in intermittent hypoxic exposure.

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PC95

Power distribution in the camouflage pattern of a squid (*Loligo vulgaris*)

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Differential output of motor units during neuro-muscularly generated colour change has been assessed by comparing the expanded sizes of elements served by units that darken the skin of a squid, with their size at rest in a pale skin. The wide range of resting sizes of pigment spots (retracted into a tight sphere at rest, Fig. 1 left) is thought to correlate directly with ontogenetic age of chromatophore organ [1] – thence with the age of motor neurons supplying them. Maximum ratios of expansion (areas) subtended by individual brown (B) and red (R) spots when the skin is dark (cf. Fig. 1 right), range from c. 30:1 to c.20:1; converted to mean diameter, ratios at any moment are a measure of the shortening of chromatophore muscle and thus of firing frequency [2, 3].

Figure 2 shows the contribution that red/brown spots make to one of the common camouflage dresses worn by a squid. At medium intensity of expression, relative power falls off with increasing resting-size/age of chromatophore organ. [N.B. were the squid to have turned all-dark (maximum intensity) the curve would be nearly flat].

Evidently fine gradations of tone are achieved across a limited range of firing frequencies (data not shown) by bringing in the units of small (younger) spots first and of large (older) spots last. It recalls the way motor-unit recruitment grades the power output of vertebrate limb muscles – with here an additional developmental signature.
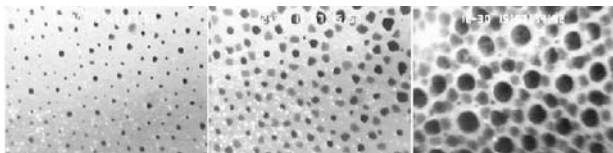

Figure 1. Frames from video-clip of natural colour change (from pale, through lightly shaded to dark) in Loligo vulgaris (captive squid, dorso-lateral mantle surface, c.1cm2).
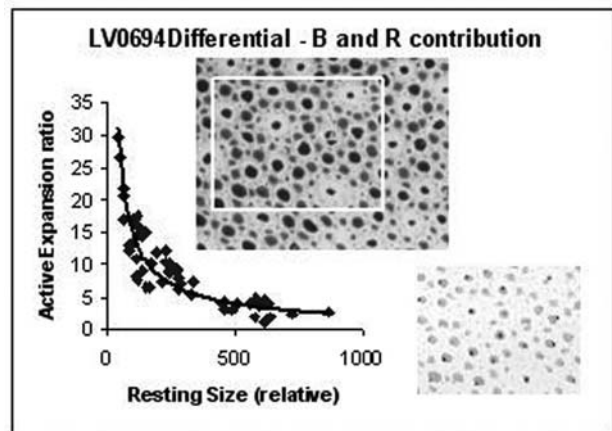

Figure 2. Differential contribution of brown and red spots to counter-shading pattern of medium intensity (detail c.1cm2). Still photograph, hand-held camera. [Right, same pattern at lower intensity overlaid by spots at resting size].

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Photoshop; U.S. National Institute of Health (NIH) freeware for ImageJ ; squid fishermen Bay of Naples.

PC96

Optimal control predicts human performance on objects with internal degrees of freedom

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Humans regularly interact with objects with internal degrees of freedom from carrying a cup of coffee to folding a shirt. While objects with no internal degrees of freedom can be regarded as some kind of extension of our limbs, non-rigid objects pose a more complex control problem. In recent years stochastic optimal feedback control has emerged as a framework for human motor coordination. Optimal control has been used to explain average movement trajectories as well as trial-by-trial variability in a wide range of motor behaviours, such as obstacle avoidance and bimanual coordination. In this study, we investigated whether the optimal control framework can be extended to object manipulation with internal degrees of freedom and whether it can account for the complex behaviour necessary to control such objects. We used a virtual reality set-up together with a vBOT robotic interface to simulate the dynamics of a virtual object attached to the subject's hand (for