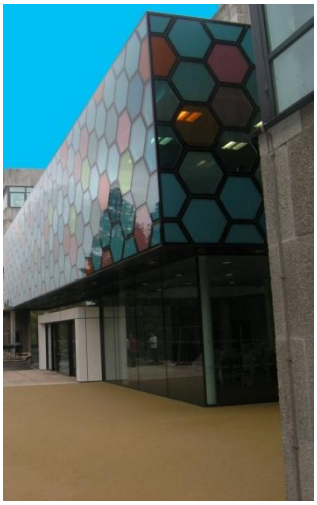
Anatomical Research at Cardiff University

Since 1999, anatomists at Cardiff have belonged to the Cardiff School of Biosciences, although anatomy has been taught in the city's various HEIs since 1883 (the first Professor of Anatomy was appointed in 1893).

The Cardiff School of Biosciences is best known for the work of its former director, Professor Sir Martin Evans FRS, who was recognized by the award of the Nobel Prize in Physiology or Medicine in 2007 (together with Mario Cappechi and Oliver Smithies) "for their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells". Its current director, Medical Research Council Professor Ole Petersen CBE FRS, pioneered patch clamp single channel recordings in epithelial cells and discovered intracellular calcium tunnels in exocrine gland cells. The School provides impressive modern facilities for teaching and research. The School's research is recognized at the highest levels. Alun Davies (Distinguished Research Professor), the Nobel Laureate Robert Huber (Visiting Professor) and Ole Petersen (the Director of the School) are Fellows of the Royal Society. Four members of staff (Professors Alun Davies, Vincenzo Crunelli, Stephen Dunnett and Ole Petersen) are Fellows of the Academy of Medical Sciences.

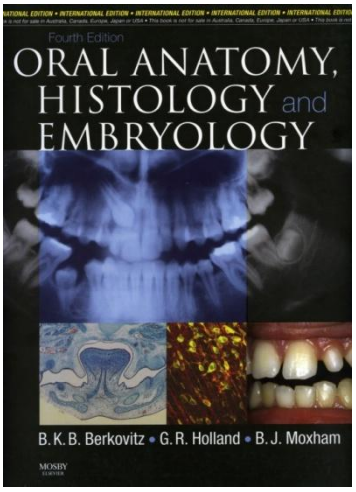
The Cardiff School of Biosciences is one of the largest bioscience departments in the UK with over 100 academic staff, ~150 research staff, more than 160 postgraduates and ~2000 undergraduate students. Supported by state-of-the-art facilities, its courses and research span the full range of the Life Sciences from whole (eco)systems to molecular biology to the anatomical sciences. In the 2010 Annual World University Ranking compiled by Shanghai Jiao Tong University (http://www.arwu.org), Life Sciences at Cardiff University is in the top 100 worldwide and in the top 10 in the UK.

The School contributes to Cardiff University's medical and dental courses, delivered in partnership with the Schools of Medicine and Dentistry. In addition, the Anatomical Sciences Honours science degree is part of the School's Biomedical Sciences portfolio. Cardiff's teaching of anatomy is characterised by student-directed learning through practicals involving dissection of cadavers by the students. All our undergraduate courses have been graded as 'excellent' by external assessors and, according to the most recent National Student Survey, are 'highly regarded' with the anatomical sciences placed near the top of the subject league.

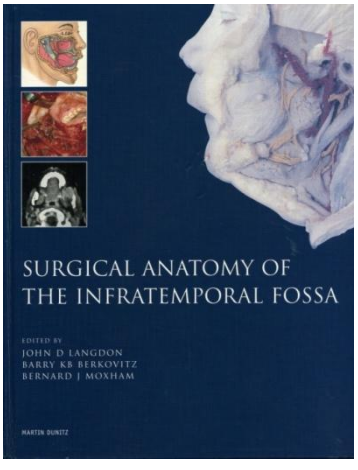


The School's research is conducted essentially within 4 research divisions: Organisms & Environment, Molecular Biosciences, Pathophysiology & Repair and Neuroscience. For the anatomical sciences, research is centred mainly

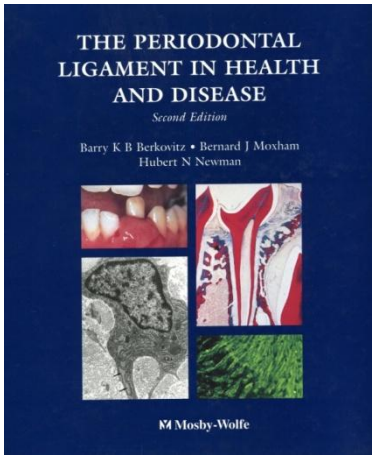
upon connective tissue biology (within Pathophysiology & Repair), neuroscience and pedagogic research.



Professors Archer, Caterson, Moxham and Drs Hughes, Kwan, Ralphs and Shaw work within the realm of connective tissue biology. **Professor Charlie Archer** investigates synovial joint biology. He is interested in the development of joints and, in particular, mechanisms of formation of articular cartilage and the process of joint cavitation. His research group is also interested in the application of the knowledge gained from developmental studies towards biological repair of joint damage (particularly articular cartilage). His group have isolated a progenitor cell from the surface zone of developing articular cartilage and have found that this cell can be expanded extensively in monolayer culture without loss of chondrogenic potential, a limitation of differentiated articular cartilage. Thus, Prof Archer is developing this cell with a view to its use in biological repair procedures of articular cartilage. **Professor Bruce Caterson**'s research is based on the production, development and use of monoclonal antibody technologies for studies of connective tissue proteoglycan metabolism in health and disease. These studies have focussed on matrix proteoglycan metabolism in musculoskeletal tissues, with a particular emphasis on studies involving molecular mechanisms underlying the pathogenesis of degenerative joint diseases (i.e. osteoarthritis and rheumatoid arthritis). **Professor Bernard Moxham's** interests in connective tissues extend to their role in craniofacial biology and development, focusing on the structure, function and pathophysiology of the periodontal connective tissues in the mouth and on craniofacial development and congenital abnormalities. The periodontal ligament is responsible for resisting masticatory loads and for providing the forces of eruption. His research has characterised the structural, ultrastructural, biochemical, and biomechanical properties of the periodontal ligament and his work has resolved problems regarding the mechanisms responsible for tooth eruption and for the way in which the periodontal ligament resists masticatory loads (the tooth support mechanism). His research has also shown that the periodontal ligament maintains foetal/mesenchymal characteristics; leading to the isolation of embryonic stem cells in and around the tooth. In terms of craniofacial development, abnormal development of the mesenchymes in palatal shelves is responsible for the formation of palatal clefts. Professor Moxham's research group has highlighted the importance of palatal shelf ECM in the generation of turgor pressure to facilitate palatal shelf elevation. In collaboration with colleagues at Thessaloniki, he is studying the effects of teratogens on craniofacial and brain development, showing that folic acid can "rescue" even major craniofacial abnormalities produced by teratogens. Research in Greece has also shown that parental socio-biological features "predispose" to the development of craniofacial congenital abnormalities. The work on craniofacial development was awarded the Enrique Martinez Moreno prize.

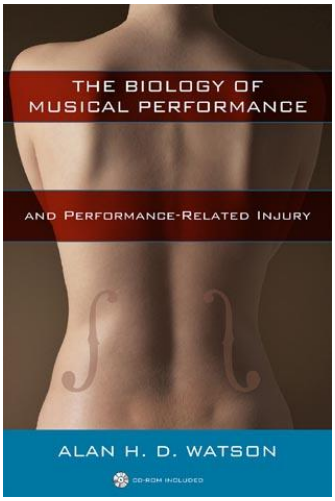


Research in **Dr Clare Hughes's** laboratory has been focused towards bettering our understanding the role and mechanisms the proteinases play in the destruction of aggrecan in cartilage. Her group is also investigating the potential of biomarkers that can be used for diagnosis, distinguishing disease progression and monitoring the efficacy of surgical and therapeutic interventions. She is further studying the use of nanotechnology for drug delivery in arthritis. **Dr Alvin Kwan**'s research is concerned with the regulation of chondrocyte maturation during endochondral ossification. Current research activities have focussed mainly on two potential regulators of cell differentiation in the growth plate – type X collagen and Small Acidic Protein (SAP). **Dr Jim Ralphs** investigates how cell populations of fibrous connective tissues deposit and modify highly organised extracellular matrices. Using tendon, cornea and bone as experimental tissues, and a range of developmental and in vitro methodologies, his work relates cytoskeletal architecture, cell shape, cell orientation and cell-cell interactions to extracellular matrix architecture, composition and function. **Dr Hannah Shaw**'s current scientific research relates to the role of adipose tissue and fascia in the musculoskeletal system. This interest focuses on entheses (attachments of tendons and ligaments to bone, specifically the calcaneal (Achilles) tendon enthesis organ) and the importance of adipose tissue at these sites. Her work has shown that, although entheses are common sites of pain in pathology, under normal conditions the enthesis itself (and associated fibrocartilages) are avascular and aneural. The related adipose tissue, however, is highly innervated and may therefore play a role in proprioception, and potentially be a source of pain in enthesopathies. From this research Dr Shaw has developed an interest in the functional role of adipose tissue in the musculoskeletal system and she is investigating the structure and development of the plantar fat pads.



Professor Alun Davies and Drs Santer and Watson are neuroscientists. **Professor Alun Davies** uses a wide variety of cellular, molecular and transgenic approaches to understand the regulation of neuronal survival and the growth of neural processes in the developing nervous system, focusing on the functions and mechanisms of action of neurotrophic factors. His group mostly works on experimentally advantageous populations of neurons in the peripheral nervous system, but they have begun to apply their multi-disciplinary approach to study dendritic development in the central nervous system. They have established well-characterised cell culture systems to ascertain the roles of neurotrophic factors at defined stages in neuroblast and neuronal development and they use transgenic technology to investigate the consequences of null mutations the genes encoding these factors, their receptors and other regulatory molecules. They also have a particular current interest in the role of the NF-kB family of transcription factors in regulating the growth of neural processes. Using advanced morphological, tract-tracing and immunohistochemical methodologies, **Dr Robert Santer** studies the autonomic nervous system with special reference to the effects of ageing on the urinogenital system, the enteric innervation, pelvic ganglia and the supraspinal control of preganglionic neurones in the spinal cord. He also investigates cell loss in the human autonomic nervous system in health, ageing and disease. **Dr Alan Watson**'s current research is focused on various aspects of spinal cord circuitry.

This includes presynaptic inhibition of sensory neurones and the effect of ageing on pathways that control the lower pelvic viscera and pelvic floor. The latter is directed at changes in the central and peripheral components of autonomic visceral innervation, the somatic innervation of the pelvic floor, and the descending pathways that control them. He is also involved in public engagement in science. His particular interest is in providing courses for musicians on the biological principles underlying performance and performance-related injury. This also includes research projects into respiration in musicians. His book on the *Biology of Musical Performance and Performance Related Injury* was published in 2009. This work received a "Maximising Impact Award" from the School in 2010.



Pedagogic anatomical research at Cardiff is conducted by **Professor Bernard Moxham** and **Drs Alvin Kwan, Hannah Shaw and Tracey Wilkinson**. Professor Moxham founded a Trans-European pedagogic research group for the anatomical sciences. Presently, this group is comparing the legal procedures operating for body bequests across the EU, investigating the attitudes of medical and dental students to the clinical relevance of the biomedical sciences, assessing the meaning of research-led teaching in higher education, determining the mathematical and literary skills possessed by science, medical and dental students when first they enter university, and investigating the relationships between course aims/learning outcomes and teaching methods employed for topographical anatomy. Further work is investigating the knowledge possessed by science, medical and dental students about the philosophy of science and of ethical frameworks, the understanding of clinical medicine possessed by newly recruited medical students, and how personality differences relate to attitudes and learning styles for students in the health professions and in biosciences. Dr Shaw is studying the use and impact of online tutorials for student practical class preparation. At present, this study is focusing primarily on anatomical teaching within the dissection room, but in the future will branch out to other science disciplines. In addition to her interest in human variation, biomechanics, and ergonomics, Dr Wilkinson is assessing student learning styles and personality and how they might have an influence on assessment. Dr Kwan is also studying student personalities and in relation to examination performance. The group are developing new student-directed learning pedagogies that, building on the idea of modularisation of courses, see the development of "shadow modules" run by the students themselves to complement teaching from within standard modular arrangements. The shadow modules will have student shadow module leaders and be provided with a collaboration platform through a universally accessible web portal (including mobiles and tablet PCs).