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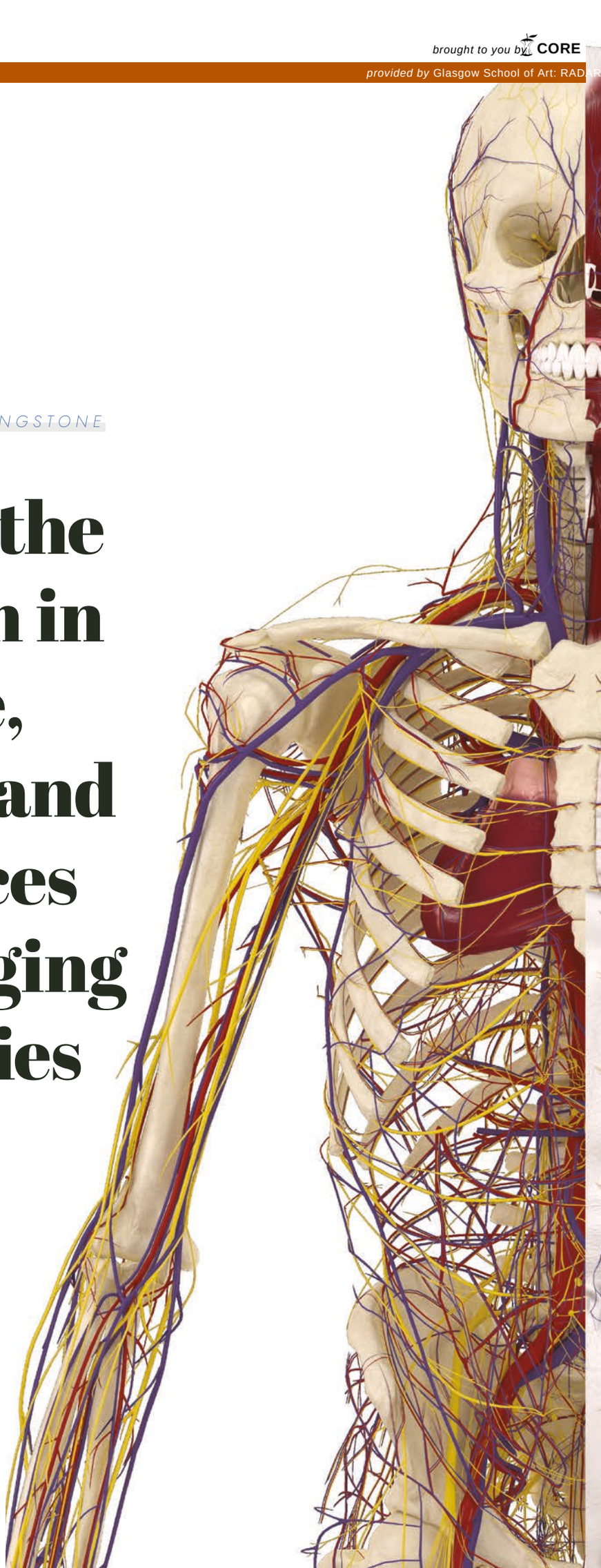
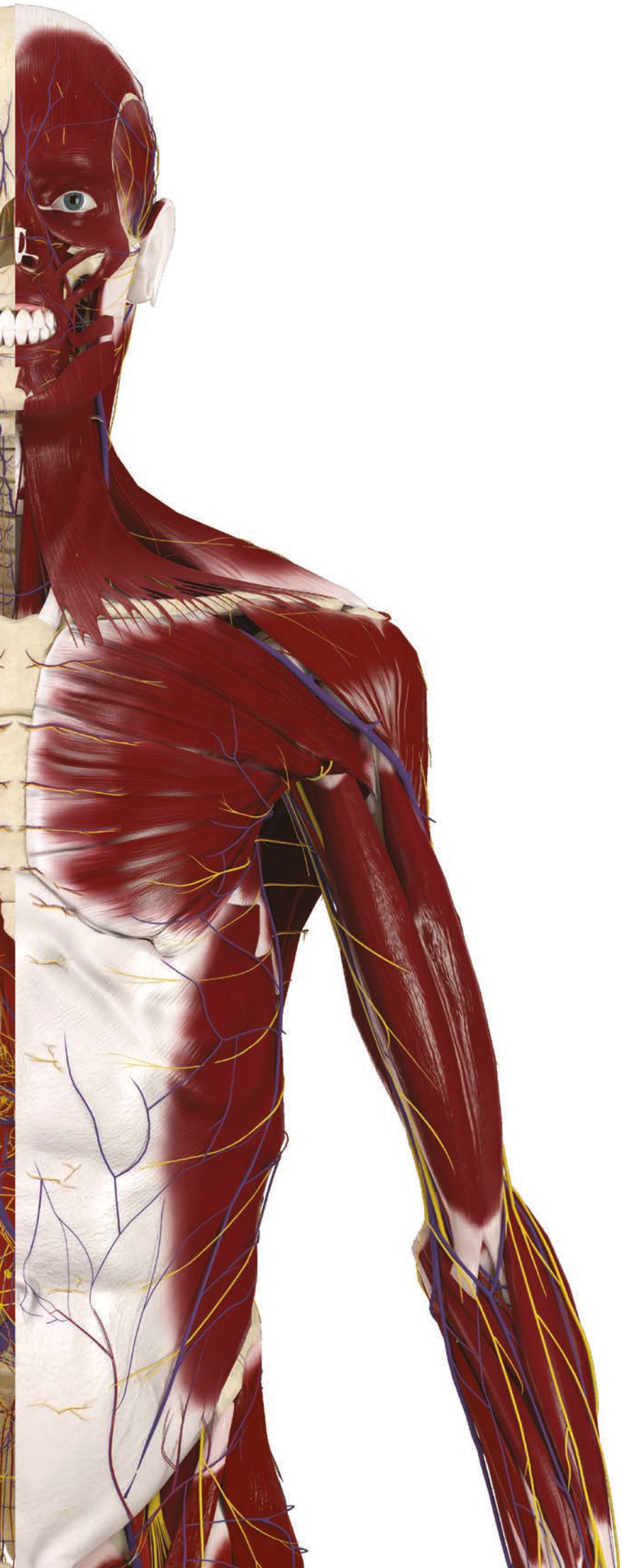
Enhancing the Curriculum in Medicine, Veterinary and Life Sciences Using Emerging Technologies





The acquisition and reinforcement of foundational anatomy knowledge is a fundamental aspect of the curriculum of future professionals in healthcare education, biomedical communication and dissemination. Higher education institutions involved in medical, life sciences and veterinary training have endeavoured to implement motivating and engaging learning environments and these can include prosections and dissections of cadaveric material. Facilitating such learning environments can be often limited by legislation and economic challenges which can be challenging for some universities. Although the proposed environments usually support self-directed and collaborative learning, they can be cognitively challenging for students due to the limited access to physical resources in facilities (e.g. cadavers in an anatomy laboratory). The challenges of adopting a blended learning approach with traditional teaching can become discouraging for the appreciation of spatial relationships between anatomical structures and the understanding of variability. Consequently, alternative pathways towards sustainable and innovative learning and teaching in medical, life sciences and related veterinary education need to be explored.

Emerging technologies such as Extended Reality offer opportunities for the disruptive transformation of the current learning and teaching in higher education, in favour of a more user-centric approach based on a self-paced and constraint-free discovery paradigm. Extended Reality includes representative forms such as Virtual Reality and Augmented Reality. Virtual Reality defines a technological framework which gathers visualisation and interaction interfaces, and empowers a user to be physically immersed and psychologically involved in an interactive computer-generated environment. Augmented Reality consists of the overlay of digital models onto the real world, being either marker-based, when an image is used to trigger digital models, or marker-less, when users decide the location of digital models in the real world. Augmented Reality can be achieved using either mobile technologies such as smartphones and tablets, or cutting-edge see-through headsets like Microsoft HoloLens or Magic Leap.

Previous studies have highlighted the impact of Virtual and Augmented Reality on learning and teaching in medical, life sciences and veterinary education, suggesting it promotes a higher degree of understanding and critical thinking, thus fostering deeper cognitive involvement. Virtual and Augmented Reality support enhanced interactions with digitally reconstructed anatomical models, offering opportunity for providing additional sensory feedback as a result of these interactions. Interaction outcomes can result simply in the provision of additional visual and audio feedback for further cognitive engagement, or can be provided in a more intrinsic form using haptic devices to simulate the tactile and kinaesthetic sensations experienced in the real world, allowing improved motor skills that are required in complex biomedical procedures. ▶

From a long standing strategic research-led partnership between the School of Simulation and Visualisation (SimVis) at the Glasgow School of Art, and the Anatomy Facility at the University of Glasgow, we have created a unique and innovative taught postgraduate degree, the MSc in Medical Visualisation and Human Anatomy. This degree combines training in interactive visualisation technologies with intensive full-body anatomical training, including cadaveric dissection.

SimVis, an undergraduate and postgraduate research centre, provides an intense learning and research environment which exploits the interface between science, technology and art to explore imaginative and novel uses of advanced 3D digital visualisation and interaction paradigms. The Anatomy Facility is one of the UK's busiest anatomy facilities, involved in both undergraduate and postgraduate anatomical training, and provides innovative and challenging education and training package for physicians, surgeons, dentists and allied health professionals for continuing professional development.

This joint effort gathers the respective expertise of two internationally recognised institutions aiming to provide graduates with a unique interdisciplinary skillset, making them highly employable in the field of medical visualisation and interactive illustration.

The unique composition of the programme allows us to build upon multidisciplinary teamwork and professional development activities between life sciences, medical and biomedical graduates, and others with different backgrounds such as computer sciences, health informatics, digital arts, or equivalent professional practice. Throughout a three-stage course, students undertake: (Stage 1) basic and advanced training in creating 3D visualisation of MRI and CT datasets using image analysis and volumetric visualisation platforms, using standard 3D modelling and animation packages to create anatomically accurate digital reconstructions, and interactive application development using ground-breaking modern game engines which offer a user-friendly solution to the implementation of non-immersive and immersive medical visualisation; (Stage 2) intensive anatomy training with focus on the global legislation framework on body and organ donation, the history of anatomy and medical terminology, and laboratory-based practices which include prosections, histology, and cadaveric dissection; and finally, (Stage 3) a self-directed final research project which provides students with the opportunity for blending the taught 3D visualisation technology and human anatomy skillset towards the completion of fully functional implementation or animations to support the learning and teaching in higher education, the specialised communication to healthcare professionals and patients, and scientific dissemination to the wider audience.

As a result, our graduates deliver creative methodological and technological developments to improve the visual understanding of many specialities across the biological, medical, veterinary and allied health professions. ■

IMAGE CREDITS: MSc in Medical Visualisation and Human Anatomy.

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