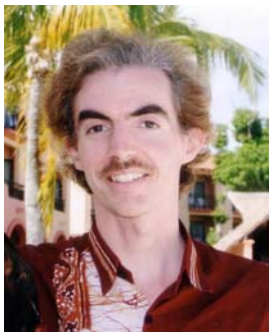
Profile of Dr David W Green

Dr. David W. Green MBiol. CBiol.



I am guided by the philosophy of learning lessons from nature and the good design evolved by natural selection- to solve key problems in **biomedical engineering and regenerative medicine**.

I am focused on commercialisation of my Intellectual property and medical product design and development.

Research Theme
Tissue Bionics: Advanced biomimicry strategies for regenerative medicine

The generation of more clinically acceptable products-such as scaffolds-for the establishment, growth, regeneration and transplantation of fresh human tissues, personalised to each patient, is an immediate economic and social imperative. One of the most intractable elements of tissue engineering is the production of *scaffolds* that properly support cells and tissues.

One *new* approach in scaffold technology is to harness the problem solving inventiveness -that has evolved throughout nature- to devise better ways of growing whole new tissues outside the body. Significant lessons can be learnt from the study of natural structural biomaterials- such as, seashells and corals- which have complementary structures and biology- at least at the molecular level-to human tissues. These non-human organism represent good and simplified design models for the tissue engineer to rebuild fresh human tissues in the laboratory.

Many functional designs in non-human organisms can be used to develop a new generation of scaffolds that completely re-engineer human tissues and organs outside the body. Clinically useful analogues with several common features to native human tissues can be fabricated through judicious surface modifications of natural skeletons taken from many different organisms. Alternatively, these structures are mimicked in a special way using synthetic chemistry and nanotemplating, for example.

A database that provides direct access to all problem solving strategies used by nature is used to formulate inventive technological solutions to the design and fabrication of scaffold materials and structures using AskNature taxonomies, BioTRIZ and TRIZ matrices. Such an approach can reduce the degree of complexity of re-engineering a given tissue. One other route towards the design and fabrication of scaffolds is to learn ideas from the evolutionary biology of the tissue and organ to be replaced and by drawing from ideas in *darwinian* medicine.

For the past decade I have designed and fabricated inorganic-ceramic-organic and composite structures with intricate and complex morphologies as archetypal templates for regenerating mineralized bone and cartilage tissues. This research began at the University of Southampton and the University of Bristol, UK in 2000. The study of bio-mineralization provides us with detailed information on how bio-minerals are synthesised, arranged and integrated with organic materials to generate high performance inorganic-organic composites and then build more complex multi-level structures with matching properties to human tissues such as bone and cartilage.

I have structured many of these materials using "*green*"-non-toxic- chemistry, by self-assembly, which led to the generation of bioceramic microspheres, silica sol-gel microcapsules, polysaccharide microcapsules and nanocapsules, calcium phosphate cell nanocoatings, hydroxylapatite (carbonated) implant coatings and mineralized/ un-mineralized polysaccharide thin film coatings. Each one of these biomimetic templates have been tested and evaluated in stringent *in vitro* and *in vivo* models using primary human bone marrow cells, human chondrocytes, human adipocytes, human mesenchymal stem cells and human foetal/embryonic stem cell progenitors.

The aims were to fabricate new materials and structures that are integrated with human cells and tissues to produce "*living bio-composites*" which co-operatively evolve with host tissues. So far I have produced candidates for implant

coatings and tissue augmentation alongside devices for cell transplantation and gene/peptide/drug delivery some of which are now being commercialized (e.g. through Tissue Bionics project and BioTomo Pty. Ltd., Sydney). I have now extended these biomimetic strategies (as defined above) for ophthalmology (cornea and retina reconstruction and replacement-currently being patented) and soft tissue engineering (breast reconstruction with Xuebin Yang at the University of Leeds, UK). I am also striving to develop a range of bio-inspired biomaterial led solutions for stem cell therapies.

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