2015 YCCSA SUMMER SCHOLARSHIP PROJECT SUBMISSION

This form is for prospective project supervisors to submit their projects to be included in the YCCSA Summer Scholarships Programme for 2015.

It is the purpose of the Summer School that any projects submitted are interdisciplinary in nature.

Date	*12/1/15*
Main Supervisor's Name	*Prof Martin Bees*
Main Supervisor's Department	*Mathematics*
Co-supervisors' name(s) and Departments	*Dr Mark Coles, Biology*
Project Title	*Wound healing: contrasting individual-based and differential equation models of the epidermis*
Project Description	*Our skin is our first defence against pathogens. When this barrier is broken the body reacts with a coupled set of processes that are governed by signal molecules: inflammation, new tissue generation and structural remodelling. If this system becomes unbalanced the wound may not heal and be further challenged by infection or abnormal growth and scar formation may result.* *The skin is composed of two layers; the epidermis provides an outer covering for the structural dermis. Epidermal wounds heal through a balance of cell proliferation and migration, governed by biological processes. A variety of models of epidermal healing previously have been proposed using either continuum (PDE) approaches (reviewed in [1,2,3]) or discrete (individual-based) representations (reviewed in [3]), but little work has been done to investigate the differences between each method when applied to the same system. Recently Martin Bees (Mathematics) and Mark Coles (Biology) have set up a collaboration, jointly supervising a PhD student, to develop theoretical and in vivo experimental techniques in tandem, to provide testable and useful descriptions of the wound healing process.* *The project student will work together with his/her supervisors and the PhD student on formulating an individual based model (IBM) of epidermal skin cell behaviour during wound healing, which will be directly compared to PDE models that have already been developed in the group. To facilitate this formulation the student first will summarise the biological literature to identify key aspects of the system in the specific context of an IBM. Next the student will construct the IBM with several variations, implement the descriptions using an appropriate platform and investigate which factors and mechanisms dominate the dynamics. Parameters will be extracted from experiments performed by*

	collaborators at York or the literature. Finally, comparisons will be made of results from IBM and PDE approaches and experimental results of epithelialisation of the wound surface.
Required skills	*The project would be appropriate for applicants with a strong academic record in mathematical or computational modelling and analysis, using ordinary and partial differential equations and/or IBM methods. In which case, experience with programming (e.g. Matlab, C, Java or Netlogo) would be useful.* *Alternatively, the project would suit a student with a strong background in programming (e.g. using object oriented languages) and a keen interest in the simulation of biological systems. In which case, experience with IBM methods and/or differential equation models would be advantageous.*
Project dates	*Monday, 13 July 2015 - Friday, 11 September 2015.*
Other information	
References	*[1] Geris, L., Gerisch, A., Schugart, R., 2010. Mathematical modeling in wound healing, bone regeneration and tissue engineering. Acta biotheoretica 58(4) pp355-367.* *[2] Sherratt, J., Dallon, J., 2002. Theoretical models of wound healing: past successes and future challenges. Comptes Rendus Biologies 325 pp557-564.* *[3] Smallwood, R., 2009. Computational modelling of epithelial tissues. Wiley interdisciplinary reviews: Systems biology and medicine 1(2) pp191-201.*

When complete, please email the form to sarah.christmas@york.ac.uk