

Title: Modelling the early embryo

Main Supervisor: Krasi Tsaneva-Atanasova, **Co-Supervisors:** James Wakefield and David Richards

Project:

Background: There are still many mysteries surrounding how embryos develop, not least the earliest stages starting from a single egg. Understanding these complex and fascinating processes have important applications to global issues such as improving human fertility, IVF treatment, organ-on-a-chip technologies and economically-important animals such as pigs, cows and sheep. For example, this topic is of substantial importance in discovering better ways of scoring blastocyst quality in IVF clinics, which could dramatically improve fertility, issues that have devastating health, psychological and economic impact, and which will only become more acute as women increasingly delay having children until their 30s.

Key research questions: What are the fundamental rules underlying embryo development? How do these rules differ between animals? What are the failure mechanisms during early embryogenesis and how common are these? How much can the system be perturbed without altering the final outcome?

The project: Recently, we have used mathematical modelling and computer simulation to shed light on the very first few days of human embryogenesis. During this interdisciplinary PhD, you will extend this work to apply to later stages of development and to other animals such as the fly. This will involve a combination of mathematics, computer simulation, microscopy and image analysis to investigate fascinating questions such as the fundamental rules governing embryo development. In particular, you will consider both vertex models and cellular Potts models, using a variety of programming languages, and get to spend time in the lab acquiring your own microscopy images.