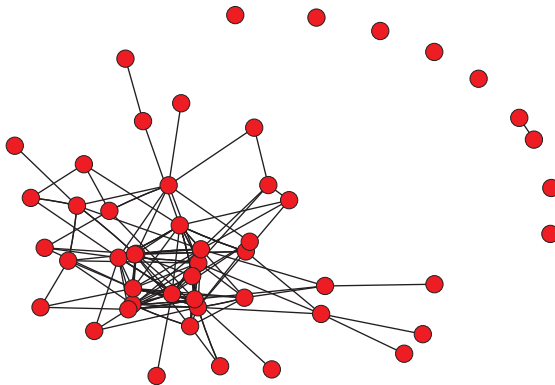


Systems Biomedicine Graduate Programme at King's College London



- 1 Introduction to the Systems Biomedicine Graduate Programme
 - The need for the programme
 - Objectives of the programme
 - The context of a PhD
- 2 Implementation of the Systems Biomedicine Graduate Programme
 - Lectures
 - Seminars
 - Apprenticeships
- 3 Track record of the Systems Biomedicine Graduate Programme
 - Departments and academics involved
 - PhD Projects in 2008/09
 - PhD Projects in 2009/10
- 4 Future of the Systems Biomedicine Graduate Programme
- 5 Further details and contacts



Introduction - the need for the SBGP

- Recent years have witnessed a 'data tsunami' in biomedicine. We now have unprecedented and still increasing amounts of sophisticated high quality data, such as genetic information, high-resolution in-vivo images of cell processes and large-scale population data.
- Just as extensive astronomical data paved the way for Kepler and Newton to revolutionise physics, the biomedical data tsunami has the potential to revolutionise medicine, if we can use these data effectively for understanding the complex systems from which they are extracted.
- Post-genomic biomedicine requires effective collaboration of scientists from many disciplines, working together in research teams that combine the methods, skills, and knowledge from cellular and structural biology, bio-informatics, engineering, physics, mathematics, and medicine.



Introduction - the objectives of the SBGP

- We aim to contribute to the creation of a new generation of researchers in the field of Systems Biomedicine that, while still trained primarily in one of the above stake holding sciences, have the skills, the background knowledge, and experience to work in multi-disciplinary research teams.
- We would like our new researchers to be comfortable with such teams, to have a basic awareness of the methods and styles of disciplines other than their own, and to form informal multidisciplinary networks of peers at an early stage in their careers.



Introduction - the context of a PhD

- The SBGP should not take away any time from the PhD candidates' training in their primary disciplines. In the UK the time available for doing a PhD is often modest compared to that available overseas, and even this limited time is under pressure from increasing bureaucracy.
- We see no benefit in training people who know a bit of everything but have no area in which they are specialists; we need our young researchers to be experts in their own fields, but want them to work efficiently with experts from other fields.
- We have therefore chosen to extend the PhD training period of each participating student by six months, and to invest this extra time in a programme of **lectures**, **seminars** and **apprenticeships**.



Implementation - SBGP lectures

The SBGP lectures give overviews of disciplines of relevance in biomedical research, presented in a way that makes them accessible to all. For example, the 08/09 session had a programme of 34 lecture hours which covered:

- Principles of cellular organization - genes, proteins, and global function
- Modern genomics
- Signalling processes on complex networks
- Opto-mechatronics, image processing and analysis for high content screening
- Protein structure and protein interactions
- Optical techniques in cellular biology
- Bayesian analysis of biological data
- Systems biology and cancer research
- Statistical genetics



Implementation - SBGP seminars

The SBGP seminars focus on presenting research within the broad field of Systems Biomedicine that has a clear multi-disciplinary aspect. In the 08/09 session, seven SBGP seminars were offered, including

- Prof Stephan Beck (UCL):
Reverse phenotyping: towards an integrated (epi)genomic approach to complex phenotypes and common disease
- Dr Rachel Errington (Cardiff University):
Systems Biology: high-content kinetic screening of anti-cancer agents
- Prof Bertie Gottgens (Cambridge University):
Transcriptional networks in blood stem cells
- Prof Mark Girolami (University of Glasgow):
Inference-Based Modelling Establishes the Role of BRAF in ERK Signalling
- Dr Clemens Franz (Universität Karlsruhe):
Using micro- and nanostructured biomaterials to study cell adhesion and migration



Implementation - SBGP apprenticeships

What are they?

- Three-month placements of PhD students in departments other than their own, where they participate at the work floor level in research, carrying out small projects or 'shadowing' local PhD students.

Examples of PhD projects from 08/09:

- 'Systems biology analysis of a nuclear protein interaction network during entry into the cell cycle', by a medical student who did her apprenticeships in a cell imaging group and in a bio-informatics group.
- 'Advanced Bayesian analysis of proteomic data', by an applied mathematician who used his apprenticeships to carry out experiments of the type that generate the data which he will analyze for his PhD.

Each student will do two apprenticeships.

The opportunity to climb over fences surrounding traditional disciplines enriches the training of our students.



Track record - Departments and academics involved

Eight KCL Departments were involved in the first session 08/09 of the SBGP. In 09/10 two further Departments joined the programme.

The SBGP now covers four Schools of the College, and connects academics from four of its campuses:

- Guy's Campus: Randall Division, Cancer Studies, Genetics, Dental Institute
- Strand Campus: Physics, Mathematics, Bioinformatics, Engineering
- Denmark Hill Campus: Cancer Studies, Institute of Psychiatry
- Waterloo Campus: Pharmacology



Track record - PhD projects in 08/09

- Systems biology analysis of a nuclear protein interaction network during entry into the cell cycle
(Cancer Studies, Denmark Hill campus)
- Systems biology analysis of a nuclear protein interaction network
(Cancer Studies, Denmark Hill campus)
- Bioinformatics of disease gene networks
(Genetics, Guy's campus)
- Advanced Bayesian analysis of proteomic data
(Randall Division, Guy's campus)
- Synthesis and analysis of genomic networks
(Bioinformatics, Strand campus)
- High speed fluorescence lifetime detection for optical proteomics
(Physics, Strand campus)
- Defining exposure and outcome in the context of a large secondary care database
(Inst of Psychiatry, Denmark Hill campus)



Track record - PhD projects in 09/10

- Macroscopic properties of protein-protein interaction networks: a systems approach (Randall Division, Guy's campus)
- A phenolog approach for identifying gene abnormalities in chronic lymphocytic leukaemia (Cancer studies, Denmark Hill campus)
- Hybrid physical/chemical gelatin scaffolds for tissue engineering (Pharmaceutical Sciences, Waterloo campus)
- Pathway analyses and bioinformatics analyses of function in GWAS data (Inst of Psychiatry, Denmark Hill campus)
- Stem cell maintenance during ageing (Cell and developmental biology, Guy's campus)
- Molecular dynamics simulations of the transport within silica-based nanodevices (Engineering, Strand campus)
- Bioinformatics and cell biology based analysis of fatty acid transporter regulation in the placenta (Pharmaceutical Sciences, Waterloo campus)



Future of the SBGP

- The College has supported the SBGP in both 08/09 and in 09/10 via a number of six-month PhD grant extensions for eligible students, as well as two full SBGP PhD studentships.
- On a longer term it is the objective to secure research council support, and convert the SBGP into a **comprehensive PhD programme in Systems Biomedicine**.
- The first year of the full programme would be devoted to lectures and apprenticeships and lead to an MSc degree. This would be followed, upon successful completion, by three years of research on a topic that involves the application of advanced quantitative methods from the mathematical and natural sciences to biomedical problems.



Further details and contacts

SBGP website:

www.mth.kcl.ac.uk/SBGP

management of the SBGP:

- Prof ACC Coolen
Dept of Mathematics and Randall Division
ton.coolen@kcl.ac.uk
- Dr F Fraternali
Randall Division
franca.fraternali@kcl.ac.uk
- Dr P Barber
Gray Institute (Oxford) and Randall Division
Paul.Barber@rob.ox.ac.uk

