**Undergraduate Practical Bursary Scheme- 2017**

The aim of this scheme is to support final year students to work in lab for up to 5 weeks to develop a lab practical, field or data analysis exercise for undergraduate teaching. We will be supporting the following 12 projects over summer 2017.

1. **Steve Matthews (Year 3 Structural Biology and Drug Discovery):** **s.j.matthews@imperial.ac.uk**

Combining the analysis of structural and drug ligand binding data for Hsp70

Contact Prof Matthews for further information

1. **Michalis Barkoulas (Year 3 Mechanism of Gene Expression):** **m.barkoulas@imperial.ac.uk**

Introducing a *C. elegans* RNAi practical to the module of “*Mechanisms of Gene*

*Expression*”

During the lectures of this third year module, the students hear about various techniques available to control gene expression including RNAi. However, there is currently no other practical to provide them with hands on experience. To this end, *C. elegans* offers a great teaching opportunity because RNAi works very easily and rapidly by feeding nematodes with *E. coli* expressing dsRNA.

We propose a 1 week practical to allow students to perform a complete RNAi experiment starting from a) feeding nematodes with *E. coli* clones to b) observing phenotypic changes under a light microscope (i.e. morphological phenotypes) and a fluorescence microscope (e.g. loss of GFP expression in a suitable reporter strain) and c) quantifying molecular changes at the mRNA level (using RT-PCR). By combining these various techniques, the students will be introduced to a broad range of modern techniques used to study gene expression in intact organisms.

To develop this new practical, it is vital to choose the right bacterial clones (for example targeting chromatin or transcription factors would be very suitable) and *C. elegans* strains to use (e.g. GFP reporter lines). It is also important to design and test conditions for the molecular validation. Thus, the student will help in performing test RNAi experiments, RT reactions and PCR validation in order to choose the treatments that are more likely to give straightforward results. The student will also help in drafting protocols needed for the practical.

**Desired student skills:**

* Experience in working under sterile conditions in an independent way.
* Experience in keeping good record of experimental methods and drafting protocols.
* Some experience in PCR and molecular biology.
* Some experience in light and fluorescence microscopy.
* Previous experience in handling nematodes is desirable although not essential.

**Student interests:**

* Mechanisms of gene expression and RNAi in particular.
* *C. elegans* as a model organism in research.
* Troubleshooting experiments and setting up new protocols.

1. **Tolga Bozkurt (Year 3 Advanced Immunology): o.bozkurt@imperial.ac.uk**

Imaging of pathogen infected plant cells via microscopy and UV illumination.

**Monitoring of plant disease resistance by fluorescence microscopy and UV illumination.**

Both plants and animals rely on nucleotide-binding domain leucine-rich repeat-containing proteins (NLR) to respond to invading pathogens. NLRs act as innate immune sensors that detect the molecular patterns or effector proteins derived from the pathogens.

Activation of plant NLRs often initiates a form of program cell death known as the hypersensitive response, which leads to restriction of pathogen invasion. This project is aimed at monitoring pathogen growth on plants upon deactivation of NLR type immune receptors via gene silencing. Genes encoding specific NLRs will be silenced by RNAi using agrobacterium mediated transient gene silencing. Infection will be monitored and quantified by fluorescence microscopy and UV illumination.

Principal techniques available to project include Agrobacterium mediated gene expression in plants, fluorescence microscopy, RNA interference and infection assays with the Irish famine pathogen *P. infestans.*

1. **Derek Huntley (Year 2 Biochemistry, G and G): d.huntley@imperial.ac.uk**

Development of Statistics Practical for Second Year Biochemistry

Statistics was introduced to Biochemistry this year in the second year Genes and Genomics module, consisting of 3 hour long lectures and 2 practicals of 3 hours. The practicals introduce the students to R and provide worked examples to demonstrate the material taught in the lectures. However, it was apparent that the material for the needs expanding as most students completed the work in about an hour. The objective of this project will be to research example data sets, particularly genomics, and to develop more comprehensive practicals. The student will identify and test suitable data and provide model answers that will be provided after the practical has been completed. The students will also look at the existing material with a view to updating and/or modifying it. Knowledge of R would be required for this project.

1. **Samraat Pawar (Year 1 and 2): d.huntley@imperial.ac.uk**

Computing practicals suitable for Y1 and Y2 quantitative biology

Programmatic visualization and statistical analyses of data are a necessity in all biological disciplines. The student will develop, under the guidance of Dr. Samraat Pawar, a series of computer practicals that use R to visualize and analyze data from lab and field experiments from ecological, evolutionary, genetics, and biochemistry research at Imperial College. These practicals will be integrated into the Year 1 and Year 2 Undergraduate Biology curriculum, and will be an important resource for future plans to teach programming and quantitative methods to the Biochemistry stream. The student should be comfortable in programming in R.

1. **David Mann ( Year 3 Cancer): d.mann@imperial.ac.uk**

Development of a lab on the effects of chemotherapeutic DNA damaging agents on cell lines

In order to improve the practical offered for the final year Cancer course we wish to determine the following:

1. define the lethal dose of several chemotherapeutic agents in HCT116 cells.

2. optimise western blotting conditions for several antibodies on the above cells.

3. create videos of key techniques for students to view before the practical.

These experiments will allow you to use/develop your skills in cell culture, SDS-PAGE and western blotting and cell viability assays and allow you to develop your presentation skills.  Ideally you will already have some of the above skills and a keen interest in cancer biology.  Day to day supervision will be provided by Dr Mann.

1. **Mike Sternberg (Year 1/2 Biological Chemistry teaching)**: [m.sternberg@imperial.ac.uk](mailto:m.sternberg@imperial.ac.uk)

EzMol - An Introduction to Molecular Graphics and Protein Structure

**Development of a guided tutorial to protein structure and function using the we-based graphics program EzMol**

The Sternberg group has developed a very simple to use web-based molecular graphics program EzMol

<http://www.sbg.bio.ic.ac.uk/~chris/beta.html>

The motivation is for a program that it I easy to use without needed to use via guided tab-driven wizard. The program has sufficient functionality to display proteins with information required to understand many structural and functional aspects. Its use does not require memorisation of text to input (for example to colour a region) or what to select from a host of  menu options. It is web-based so no download requirements.

The aim would be to produce a first year (and possibly a second year) practical to explain protein structure and function including:

Protein alpha, bet and coil structure

Protein a/a; b/b, a/b classes

Protein domains

Protein complexes

Protein/DNA recognition

Enzyme active sites

The globins

Antibodies and the CDRs

The student would not need to program, but clearly an interest in computing and graphics would be an advantage.

1. **Gerald Larrouy-Maumus (year 2 Biochemistry – Challenges in Cell Biology):** **g.larrouy-maumus@imperial.ac.uk**

Evaluating the impact of environmental cues on AMR in bacteria or how tolerance leads to resistance

Bacteria are everywhere in the environment. However the impact of it is underestimated , especially in the phenomenon called antibiotic tolerance.

This practical will aim to understand the mechanism of tolerance via determination of the minimal inhibitory concentration under different environmental cues such as carbon sources, ions, monitor growth of bacteria, SDS-PAGE and western-blot to identify the enzymes involved in antibiotic tolerance.

1. **Martin Brazeau ( Year 2 Vertebrate Form and Evolution):** **m.brazeau@imperial.ac.uk**

Generate 3D prints from tomography data of the skull, brain, nerves, and muscles of the skull of the modern coelacanth fish, Latimeria chalumnae.

The modern coelacanth, *Latimeria chalumnae*, is one of the only extant species of lobe-finned fishes. It is considered critically endangered and soft-tissue specimens are prized and usually unavailable for dissection. Importantly, this fish retains a very ‘primitive’ skull and jaw morphology, useful in understanding the basic anatomy of the jawed verterbate skull. This project will create virtual three-dimensional renderings of the head of *Latimeria* based on MRI scans from an online database. The resulting virtual models will be prepared as a series of ‘virtual dissections’ that will then be 3D printed in colour to serve as a unique, hands-on resource for understanding skull, jaw, brain, and eyeball anatomy in a new course on the evolution of vertebrates beginning in 2018

1. **Lauren Cator (Year 3 Disease Ecology and Epidemiology): l.cator@imperial.ac.uk**

The epidemiology and statistical mechanics of zombies

For this project the student will build a simple model in R to explore the basic behaviours of the “SZR” model. This model shares many characteristics of a basic SIR model, but in this case, is modelling the spread of…zombies.

**Alemi et al. 2015**. You can run, you can hide: The epidemiology and statistical mechanics of zombies. *Physical Review E.* 92, 0528.

 Ideally, I would like a simple R package that allows students to explore the basic behaviours of this "SZR" model (which shares many characteristics with classic SIR models) by varying parameters such as biting rate and kill rate, initial populations of human versus zombies, ect (up to Figure 1 in the paper). Students will work with this model in a computer based practical and write a short lab report analysing the outbreak and its important characteristics. I would like the students to focus on the science here and not the coding, so anything kind of programming that could minimize this for them would be great.

 The person undertaking this project would need to be comfortable with writing code in R, able to write up a simple set of instructions for how to run their code, and fearless in the face of an impending (virtual) zombie apocalypse. An interest in disease ecology and epidemiology is a plus, but not a requirement.

1. **Jake Baum (Year 3 Advanced Eukaryotic and Bacterial Cell Biology): jake.baum@imperial.ac.uk**

Developing a cell wounding practical for the new third year course

**Developing a cell migration practical for Advanced Eukaryotic and Bacterial Cell Biology**  
The practical we hope to develop is an extension of the classic “scratch test” cell wounding assay, exploring how cells migrate with the possibility of combining this with a cell motility assay tracing the migration of a motile macrophage capturing a bacterium or other particle. The experimental work flow will centre on the culturing of human cells (immortalised fibroblasts/macrophages), defining the tissue culture conditions for their management and then developing the methodologies to perturb cells and read out how they respond by microscopy followed by image analysis. The ideal student would have a background in tissue cell culture skills, with some experience in microscopy and/or image analysis (e.g. ImageJ). An active interest in cell biology is essential.

1. **Mike Tristem (Year 2 Virology):** **m.tristem@imperial.ac.uk:**

Further development of a Viral Fingerprinting practical.

Contact Dr. Tristem for further information.