Project Title: The ability of long-lived mutants to maintain metabolic homeostasis in old age
Host lab: Alic lab, Institute of Healthy Ageing
Supervisor: Dr Nazif Alic

Project outline
Alterations to metabolic homeostasis, which can result in obesity and insulin-resistance (type II diabetes) are an ever-growing concern to our society, and are at least in part due to the caloric excess of our modern diet. Both obesity and insulin-resistance have a complex interaction with a person's age. Recent exciting work in biogerontology has discovered interventions that can extend lifespan in organisms as diverse as the fruit fly and mammals. However, it remains unclear whether longevity extending manipulations can lead to better metabolic homeostasis and counteract poor diet choices, preventing obesity and insulin-resistance. This project will examine if mutations that can make the fruit fly live longer can also rescue from the effects of poor diet, using a range of techniques in fly physiology and molecular and cell biology.

Deadline for contact:
13 January 2017. Applicants should send a cover letter, brief CV & contact details of a referee.
Contact: n.alic@ucl.ac.uk
Project Title: Biology of ageing in *C. elegans*

Host lab: Gems lab, Institute of Healthy Ageing

Supervisor: Professor David Gems

Project outline

The project will involve some aspect of the biology of ageing in *C. elegans*, to be determined closer to the date of the project.

While developmental genetics has been an area of intensive study for many years, investigation of the role of genes in determining longevity and ageing only recently began. An ideal model organism in which to study ageing is the free-living nematode *Caenorhabditis elegans*. This species has well-developed genetics, its 97,000,000 base pair genome is fully sequenced, and its life span is a mere 2-3 weeks. Most importantly, numerous mutations have been identified in *C. elegans* which alter the rate of ageing, with some mutants living more than five times as long as wild-type worms. It is hoped that by understanding ageing in a simple animal like *C. elegans* we will be able to unravel the mystery of human ageing, which increases risk of a wide range of diseases, from cardiovascular disease and type II diabetes, to Alzheimer's disease and cancer.

A major focus of current work in this laboratory is understanding the genes and biochemical processes by which reduced insulin/IGF-1 signalling and dietary restriction increase lifespan. Other interests include sex differences in the biology of ageing, evolutionary conservation of mechanisms of ageing, and bioethical implications of ageing research. Our work is funded by the BBSRC, the European Union and the Wellcome Trust.

Special requirements

These projects are suited for students who are considering a possible future career in scientific research. A good grounding in genetics is helpful.

Deadline for contact:

13 January 2017. Applicants should send a cover letter, brief CV & contact details of a referee.

Contact: david.gems@ucl.ac.uk
Project title: Setting up the CRISPR/Cas technology to study sea urchin development
Host laboratory: Oliveri lab
Supervisor: Dr Paola Oliveri

Project outline
Understanding the role of regulatory genes during embryonic development is a fundamental question in biology. Recent technological advancement put the CRISPR/Cas9 as easy, versatile, cost effective and precise tool for genome editing.
In this project the student will adapt this technology, already used in many different organisms, in the sea urchin to study the function of regulatory genes expressed during the development of skeletal tissues. The sea urchin mesoderm Gene Regulatory Network is one of the best-known developmental GRN models, and provides an ideal starting point to set-up the new technology and to study the function of few transcription factors and signalling molecules so far neglected (e.g. fgf, and jun). This work has also implication in understanding evolution of skeletogenesis in deuterostomes.
The project will involve an initial step of design the CRISPR/Cas9 tool, PCR to clone the relevant components. In vitro test of the relevant target sequences, in vivo test of the technology and assessment of phenotype and genotype. Microscope imaging, PCR, cloning, generation of probes and other classical molecular biology techniques.

Special requirements
The candidate will ideally have taken Molecular Biology BIOC2001 (or BIOL2004) and Developmental Biology (BIOL2010).

Deadline for contact
13 January 2017. Applicants should send a cover letter, brief CV & contact details of a referee.
Contact: p.oliveri@ucl.ac.uk
Project title: Diet and fitness – a fruitfly model for adaptation to climate change
Host laboratory: Drosophila research group (Ground Floor Insect Facility, Darwin Building)
Supervisors: Professor Kevin Fowler & Dr Max Reuter

Project outline
Climate has a major effect on living organisms, including processes of behaviour, development and reproduction. One of the most common environmental challenges faced by species is to obtain suitable food that meets their nutritional requirements. Currently we know neither how energy intake is balanced to optimise fitness under changing climates nor how it affects the capacity of organisms to respond to climate change.

In this project we will work with Dr Florencia Camus (Marie Skłodowska-Curie Fellow, UCL) on the impact of diet on the capacity for a model organism (the fruitfly, Drosophila melanogaster) to adapt to a changing thermal climate. In a new collaboration with Associate Professor Carla Sgrò and Dr. Christen Mirth (Monash University, Australia), we will experimentally test whether nutrition mediates thermal adaptation. Flies will be fed on one of four different “defined synthetic” diets that vary in protein/carbohydrate ratios. This allows precise manipulation of all essential (and non-essential) amino acids, sugars and essential nutritional components. Flies will be fed synthetic diets for 4 days, prior to assays of their thermal tolerance. The estimates of performance (fitness) will enable us to verify whether certain diets can aid adaptation to different thermal environments.

Special requirements
Interest in evolution and genetics, experience of insect rearing, working knowledge of basic statistics.

Deadline for contact
Applicants should send a cover letter, brief CV & contact details of a referee by 13 January 2017.
Contact: Kevin Fowler (k.fowler@ucl.ac.uk) & Max Reuter (m.reuter@ucl.ac.uk)
Project title: Investigating candidate loci for sexual antagonism in fruitflies
Host laboratory: Drosophila research group (Ground Floor Insect Facility, Darwin Building)
Supervisors: Dr Max Reuter and Professor Kevin Fowler

Project outline
The reproductive roles of males and females generate divergent selection pressures. However, evolutionary responses are constrained by the shared genome. Many populations therefore harbour 'sexually antagonistic' genetic variation, where alleles increase fitness in males but decrease fitness in females or vice versa. Using genome-wide approaches, we have recently identified antagonistic loci in the fruitfly Drosophila melanogaster and generated the first insights into the genetic basis, evolutionary dynamics and functional basis of antagonism. In this project, we plan to investigate a few of our candidate genes in more detail and work towards experimentally verifying the antagonistic effects of their alleles. One interesting candidate is the gene fruitless (fru), a major regulator of sexual differentiation in the nervous system. We will measure expression levels of the gene in fly genotypes with extremely antagonistic fitness effects (high male/low female fitness or vice versa) that we maintain in our laboratory. We will do so using quantitative real-time PCR that specifically target different isoforms. Furthermore, we will assay specific tissues (e.g., brain) and measure expression at different time-points (early larval stage, pupa, adult). There is also scope to trial experiments where we attempt to manipulate expression of candidate genes and assess the effects of the interventions on male and female fitness in order to demonstrate antagonistic effects.

Special requirements
Interest in evolution and genetics is required, experience of insect rearing and working knowledge of basic statistics desired.

Deadline for contact
Applicants are welcome to meet us to talk about the project anytime. To apply, they should email a cover letter, brief CV and contact details of a referee to Max Reuter by 13 January 2017.
Contact: Max Reuter (m.reuter@ucl.ac.uk) and Kevin Fowler (k.fowler@ucl.ac.uk)
Project title: Field project with stalk-eyed flies in Malaysia

Host laboratory: Stalk-eyed fly research group (Ground Floor Insect Facility, Darwin Building)

Supervisors: Professor Andrew Pomiankowski and Professor Kevin Fowler

Project outline
The stalk-eyed fly group has been working for over a decade at the Gombak Field Centre of the University of Malaya, near to Kuala Lumpur, Malaysia. These flies are a canonical example of sexual selection based on female mate preference (Chapman et al. 2005). We intend to build on a long-term data set from natural populations and assay demographic, morphological and reproductive traits that affect sexual selection in this species (Cotton et al. 2010). Flies have been collected previously from 12 local populations along a 5km stretch of the old Gombak highway. The flies aggregate on rootlets along small streams in the rainforest. We will carry out a census of flies in the local populations: number of flies per metre, females per lek (harem size), female fecundity, morphological measures (eyespan, wing length, tarsus length, body size, testis and accessory glands). In particular, we are studying SR meiotic drive in these populations. The SR driver is X-linked and causes dysfunction of Y-bearing sperm (Cotton et al. 2014). SR males predominantly produce X-bearing sperm and thus produce strongly female biased broods. We know that there are two forms of drive in these populations – SRstrong (>90% female broods) and SRweak (70-90% female broods) – and we want to estimate the frequency of these forms of drive and relate this to the strength of sexual selection in the local populations.

References

Special requirements
The summer student will initially learn to handle flies under laboratory conditions. They will then join Prof Pomiankowski and Sam Finnegan (PhD student) for 4 weeks in the field. Conditions are tropical (hot and humid) and we will stay in very basic accommodation run by the University of Malaya. We
are looking for a robust and strong willed student with plenty of initiative and interests in evolutionary biology and genetics.

**Deadline for contact**

Applicants should send a cover letter, brief CV & contact details of a referee by 13 January 2017. Contact: Andrew Pomiankowski (a.pomiankowski@ucl.ac.uk) & Kevin Fowler (k.fowler@ucl.ac.uk)
**Project title:** The identity of novel symbionts of corals.

**Host lab:** Janouškovec lab

**Supervisor:** Dr Jan Janouškovec

**Project outline**
Symbiosis between corals and other organisms underlies the function of coral reef ecosystems - biodiversity hotspots in a state of global decline. The best studied symbionts of corals are photosynthetic dinoflagellates ("the zooxanthellae"), but corals host many other organisms including bacteria, viruses and other protists. Some of these organisms live inside coral cells and are likely to play important roles in the coral biology, but their detailed contribution to coral health and sometimes their very identity remain little known. A recent survey of sequence data revealed the existence of a novel eukaryotic symbiont in corals of an unknown morphology, provisionally termed ARL-V. ARL-V is present in multiple coral species globally and is specifically associated with coral tissue suggesting that it represents an intracellular organism - a photosynthetic symbiont or parasite. The goal of this project is to reveal the identity of ARL-V in laboratory-grown gorgonians, a group of corals in which its sequences are consistently abundant. We are working to prepare enrichments of ARL-V for DNA sequencing and microscopy work in order to characterize its life style, evolutionary origin and relationship with corals. We will provide a motivated successful candidate with training into culturing, microscopy, molecular laboratory, and bioinformatic methods.

**Deadline for contact**
13 January 2017. Applicants should send a cover letter, brief CV & contact details of a referee.

Contact: Jan Janouškovec (j.janouuskovec@ucl.ac.uk)
**Project title:** Photosynthetic endosymbiosis that represent a model for chloroplast origins.

**Host lab:** Janouškovec lab

**Supervisor:** Dr Jan Janouškovec

**Project outline**

We are trying to understand the mechanisms of how chloroplasts (and mitochondria) evolved from free-living organisms to become permanent cellular organelles, the process called endosymbiosis. We study a model interaction between two organisms in an early stage of endosymbiosis: dinoflagellates carrying diatom endosymbionts. Our goal is to characterize their relationship at a morphological and molecular level in order to provide a general model of how interaction between two free-living organisms leads to a mutual long-lasting dependency. We investigate how the division of the symbiont occurs in synchrony with the host and how the symbiont ploidy affects division in the absence of a canonical mitotic apparatus. We also study whether genes are being transferred between the two participants and are currently planning experiments to replace one symbiont with another to understand the specificity of their relationship with the host. We use culturing, cell counting, microscopy (light, fluorescent, EM) and molecular techniques (PCR, genomics, in situ protein localization) and a spectrum of bioinformatics tools to analyse the data. These methods will provide a successful candidate with an opportunity for learning and developing research skills in a research laboratory.

**Deadline for contact**

13 January 2017. Applicants should send a cover letter, brief CV & contact details of a referee.

Contact: Jan Janouškovec  ([j.janouskovec@ucl.ac.uk](mailto:j.janouskovec@ucl.ac.uk))
**Project title:** The origin of parasitism in malaria and other apicomplexans.

**Host lab:** Janouškovec lab

** Supervisor:** Dr Jan Janouškovec

**Project outline**
Apicomplexans comprise a number of important pathogens of animals including humans with Plasmodium (malaria) alone responsible for 200 hundred million new infections yearly. We are trying to understand how apicomplexans acquired their characteristic invasion structures and strategies in the first place and what were the key evolutionary transitions in the lineage that precipitated its current success. We have developed methods to generate sequence data from single parasite cells to study uncultured and little known members of the group. In parallel with investigation of their morphology and ultrastructure, this data will allow us to determine how individual components for host cell invasion, parasite secretion and movement were acquired and reconstruct the ancestral parasitic proteome in the group, which has potential practical and translational implications. The successful candidate will participate in bioinformatic analyses (wet lab training also possible with certain caveats, please contact for details) to advance this goal and gain experience with learning bioinformatics on a real biological problem. He will test different algorithms for sequence clustering and reconstruction of the ancestral proteome in the lineage, compare domain architectures between apicomplexans and their free-living relatives, and run algorithms for determining protein localization in silico.

**Special requirements**
Basic experience with Linux environment an asset.

**Deadline for contact**
13 January 2017. Applicants should send a cover letter, brief CV & contact details of a referee.

Contact: Jan Janouškovec (j.janouskovec@ucl.ac.uk)
Project title: Please follow link for available projects: http://lab.dessimoz.org/student-projects
Host lab: Laboratory of Computational Evolutionary Biology and Genomics
Supervisor: Dr Christophe Dessimoz

Deadline for contact
13 January 2017. Applicants should send a cover letter, brief CV & contact details of a referee.
Contact: Christophe Dessimoz (c.dessimoz@ucl.ac.uk)