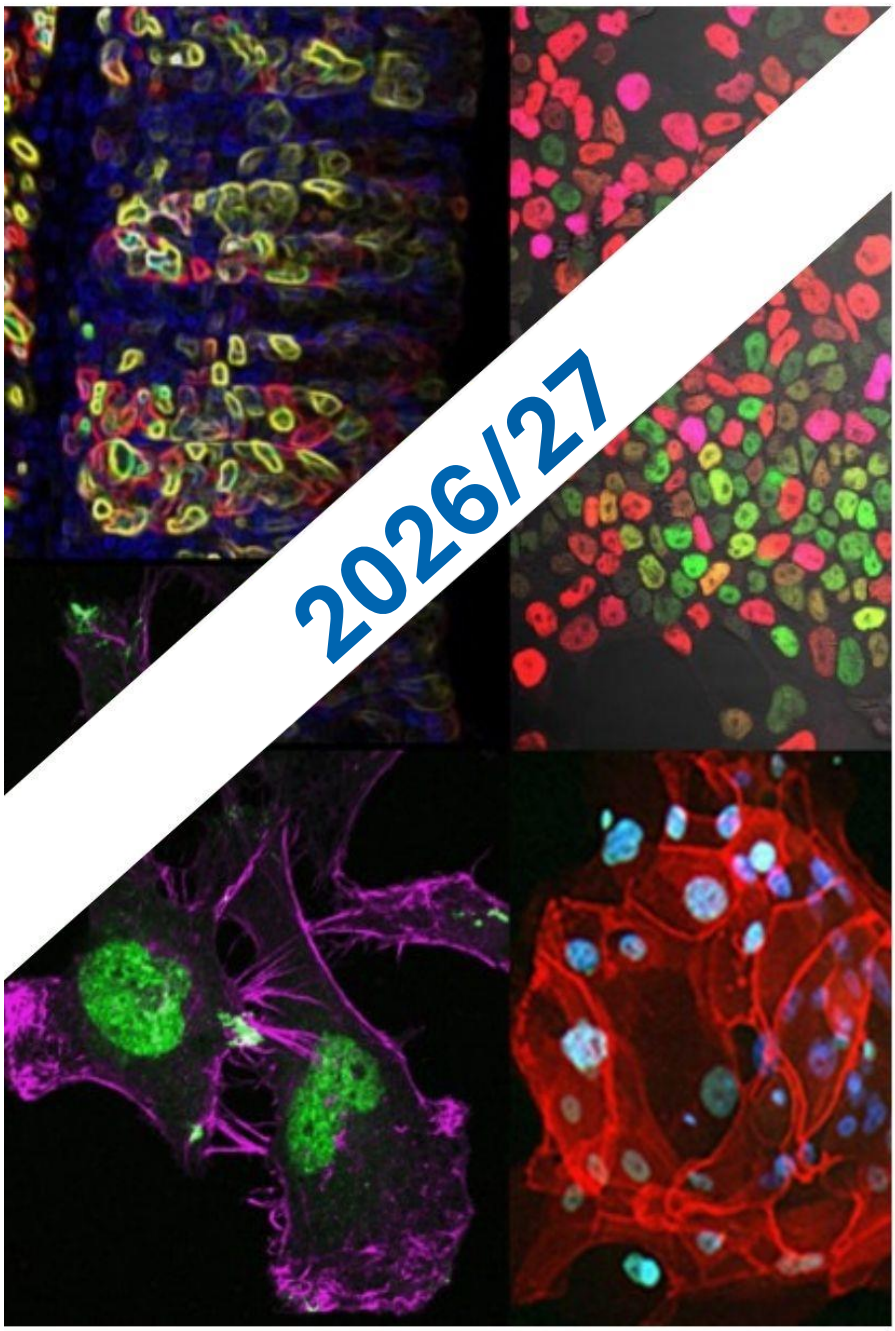
UNIVERSITY OF CAMBRIDGE

Part II Genetics



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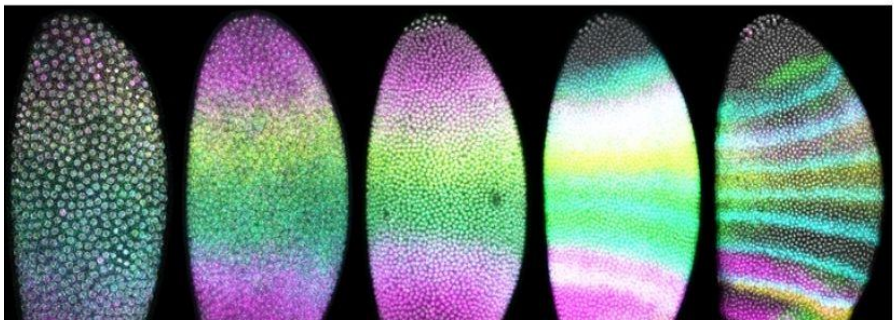

Department of genetics

NST PART II

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What is Genetics?

Genetics is the most fundamental of the biological sciences – it underpins all of biology and all biomedical research. It is the core discipline for understanding that grandest of phenomena – evolution - and, as the famous evolutionist Dobzhansky once said, 'Nothing in biology makes sense except in the context of evolution'

Sydney Brenner, who was awarded a Nobel prize in 2002 for his work on *C.elegans*, predicted 'Genetics will disappear as a separate science because, in the 21st century, everything in biology will become gene-based, and every biologist will become a geneticist' [*Trends in Genetics* 9:104, 1993].

Modern genetics encompasses an enormous diversity of topics. These can be divided into two broad categories: function, how the genetic blueprint operates during the lifetime of an organism; and evolution, how the genetic systems we see today have come about.

Function can be studied at many levels. At the level of the genome, we are interested in how DNA is copied, transcribed and repaired, how genes work and how chromosomes are organised. During development, we would like to know how groups of genes work together to orchestrate cell division and differentiation. The end-product is an adult organism whose behaviour, physiology, morphology and ecology are determined by a complex interaction between the environment and the genes it carries. Disentangling the effects of genes and environment is a further area of interest.

All organisms are the product of **evolution**. To understand the overall biology of an organism we must appreciate both the evolutionary steps that shaped it and the forces that are acting to change or maintain it now.

Sydney Brenner's prediction has proved to be largely correct, with genetics one of the most important disciplines in both the basic and biomedical sciences today. Several other Part II courses cover some aspects of genetics, but we offer a broad grounding in the subject, which will equip you for a wide range of careers, both in and outside science.

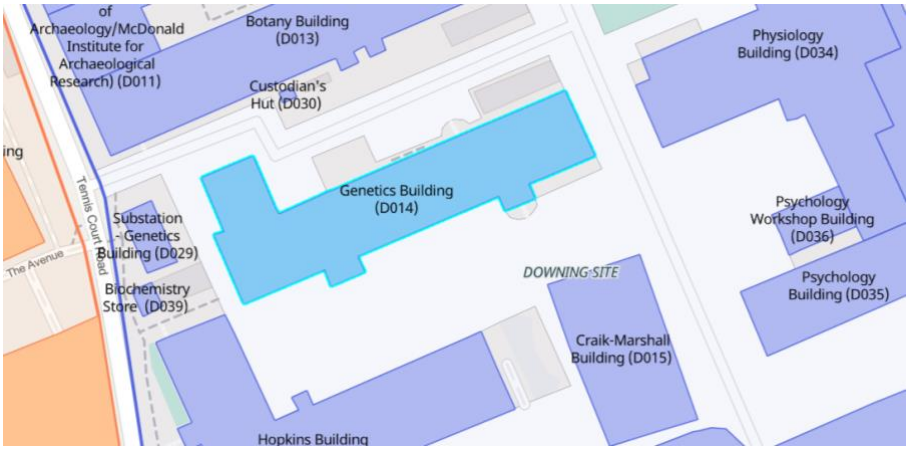
'Genetics is the most exciting subject to study. It was so 40 years ago when I started, and it is even more so now, a time when the complete genomic sequences of organisms for bacteria to humans are being made available'

Professor Michael Ashburner FRS

The Genetics Department and the Part II Class

As a Department, Genetics is small, friendly and has a much less formal atmosphere than many larger Departments. Final year students become integrated into the life and work of the Department and interact daily with the academic staff. Our Part II class averages about 30 students - small enough for the entire class to know each other and the staff and large enough to make an impact on the Department. The familiar atmosphere of the Department gives students easy access to staff and arranging supervisions, or more informal meetings, is straightforward.

A large ground floor seminar room is set aside for the use of the Part II course, and our first-floor library is shared among all members of the Department - although most of users at any one time are usually Part II students. The library has a wide range of books and journals, and computer links to the necessary e-resources. These facilities allow students to ensconce themselves in the Department during the day. The departmental tearoom is shared by all members of the department including, of course, Part II students, and this encourages a sense of belonging and familiarity.



The Department houses a wide spectrum of interests, with a common theme being the application of genetic tools to the understanding of biological problems. Areas of research include cell and chromosome biology, epigenetic inheritance, mammalian developmental biology, insect and worm development and neurobiology, plant development, microbial genetics, infectious disease dynamics, functional genomics and systems biology, and various aspects of evolution and population genetics. The breadth of interests of the Department means that it is possible to obtain tips and contacts in a wide range of research areas, which could help with your career planning. For more details, please see 'Research in the Department of Genetics' on page 20, or: https://www.gen.cam.ac.uk/research/research-groups

(Left to right, top to bottom:
Part II Class 2023/24 at their project and dissertation presentations; Cambridge science festival volunteers; Department Bake Off judging; Xmas Party; Halloween Happy Hour pumpkins; Department Summer BBQ.)

Course Aims and Objectives

(Part II Logo designed by student)

The Genetics Part II course aims to provide both a **broad overview** of the subject, and to give you an opportunity to study some **selected areas in depth**.

During the year, we aim to give you:

- A thorough grounding in the theoretical and practical foundations of basic genetics.
- An appreciation of the breadth of genetics; how genetics is applied in other disciplines.
- Detailed knowledge of selected areas.
- The chance to discuss and think about moral and ethical questions arising out of the applications of genetics to modern life, e.g. genetic counselling and CRISPR/Cas.
- Experience of research through a term-long project working within a research group (for those reading single subject Genetics).
- The ability to muster information about a topic, to critically assess it, and to communicate this information effectively in speech and writing.

What does the course entail?

The course is organised into **5 modules from which you select 4,** ensuring that you acquire the necessary breadth of background in the subject. Each module is made up of ~24 lectures. The modules aim to cover the range of genetics from cellular to organism level and will show how the latest developments (in areas such as sequencing technologies and genome assembly, functional and computational biology) are being applied to the problems of how genes in different species are organised, expressed and interact, to give the final phenotype.

Lectures generally take place between 9 am and noon, Monday to Friday, with 'extras' usually in the afternoons.

Teaching in the Department takes a variety of forms. Apart from the lectures, we provide interactive seminars, examples and data handling classes, and journal clubs. We offer supervisions with teaching staff around the time of their lectures. You will also be assigned an Adviser within the Department, with whom you meet regularly, to support your progress during the year.

In the Michaelmas term, you are offered sessions to help you make the transition to Part II, for example: sessions on essay writing, study skills, basic statistics and introductions to the online literature resources available and to bioinformatics [see page 13 – Extras].

You will have an opportunity to show your individual worth through your coursework (research project or dissertation) and the oral presentation [see page 15]. You are also encouraged to submit regular essays or specimen answers throughout the year, on which you receive feedback. This practice is vital preparation for the exams.

NST Part II Genetics and Part II BBS

You can take Genetics as a single subject in Part II of the Natural Sciences Tripos. This route will automatically involve a research project. Alternatively, you can take Genetics as your major subject in Part II Biological and Biomedical Sciences, or you can take a single Genetics module as a Part II BBS minor subject:

- Single subject Genetics in Part II NST (NST2GN)

You will do **four modules** (out of the five offered) plus the module-linked problem solving and journal criticism sessions, and the SAG discussions. You will also undertake a **research project.**

- Four paper subject in Part II BBS (414)

You **will take four Genetics modules** (including module-linked journal and problem sessions), together with another one paper (your minor subject) and complete a **dissertation**. You can select your minor subject from the list of permissible options available. Students choosing the BBS route will have Genetics as their 'home' department and have access to the same facilities as single subject NST students.

- One Genetics module taken as a Part II BBS Minor subject

Two of our modules are offered as Minor subjects to Part II BBS students: **M3 Genetics of Health & Disease** and **M4 Evolutionary Genetics & Adaptation**. In addition to the lectures, you will be expected to attend relevant journal and problem solving sessions for that module.

BBS information can be found at: http://www.biology.cam.ac.uk/undergrads/nst/bbs

There is also a separate brochure for Part II BBS as a whole, from the Faculty of Biology.

MVST - Are you a Medic or a Vet?

In most years 20-50% of the class has comprised Medical and Veterinary students, so if you are concerned about your relative lack of subject background, there will be others in a similar situation. Access to appropriate Moodle Part I course sites is provided, and background reading suggestions are provided, prior to the course, to help you catch up.

See page 30 - 'Preparation and previous courses of study'.

Genetics in IA and IB

Lecturers from the Department of Genetics contribute to a variety of IA and IB courses, so you will probably have already encountered many of us at some stage in your degree course.

For example, in the following NST courses:

Biology of Cells (IA)
Lectures from: Prof Steve Russell (The Genetic Revolution; LT) and Prof Marisa Segal (Cell Proliferation; LT).
Practicals: Lent Term - on fungal, bacterial and *Drosophila* genetics (delivered by Dr Marco Geymonat); Easter Term - on imaging cell division (delivered by Prof Marisa Segal, Prof Felipe Karam Teixeira & Dr Marco Geymonat).

Evolution & Behaviour (IA)
Lectures & practical from: Prof John Welch (Evolutionary Genetics & Adaptive Evolution in Populations; MT)

Mathematical Biology (IA)
Lectures from: Prof Aylwyn Scally (Linear algebra; MT).

Cell & Developmental Biology (IB)
Lectures from: Prof Kate Baker & Dr Antoine Hocher (Prokaryotic strategies; MT), Prof Cahir O'Kane (Genome function & evolution; MT, plus Cell and organelle regulation; LT), Prof Marisa Segal (The eukaryotic cytoskeleton and mitotic cell division; LT), Prof Ben Steventon (Xenopus & Zebrafish development; ET) and Dr Naomi Moris (Mammalian development; ET).
Practicals on mobile elements in *Drosophila* and fluorescence microscopy from Prof Cahir O'Kane (MT) and on the cytoskeleton from Prof Marisa Segal (LT).

Evolution and Animal Diversity (IB)
Lectures from: Prof Frank Jiggins (Genes, genomes and infectious disease; LT).

Mathematical & Computational Biology (IB)
Lectures & practicals from: Prof Henrik Salje (Introduction, MT and Epidemic and catalytic models, LT); Prof Richard Durbin (Phylogenies, LT); Prof Mike Boemo (multiple sequence alignment, profiles & Hidden Markov models, LT); Prof Aylwyn Scally (Linear Algebra, MT), Dr Paul Fannon (Bayesian probability, MT and Data Science, ET)

Or in the following MVST courses:

Molecules in Medical Science (MIMS) (IA)
Lectures from: Prof Christine Farr (Genetics in human and animal medicine; LT, ET)

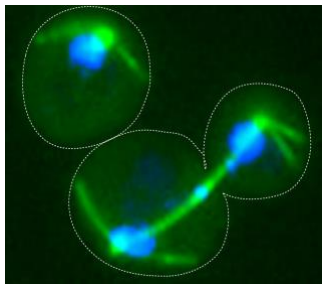
Human Reproduction (IB)
Lectures from: Prof Felipe Karam Teixeira (Human genetics and whole genome association studies; LT)

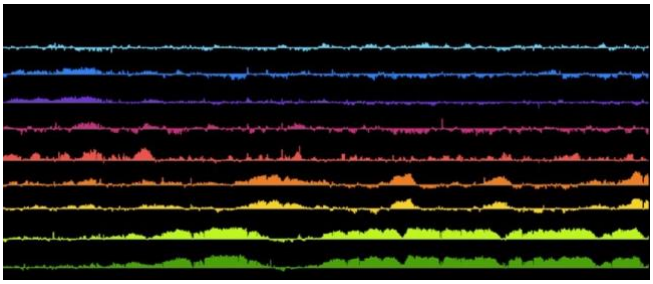
The Part II Modules

Michaelmas Term (2/2) – Compulsory Modules	Lent Term (2/3) – Select 2 out of 3
Module 1: Genomes	Module 3: Genetics of Health & Disease
Module 2: Early Development & Patterning: Genetic and Cellular Mechanisms	Module 4: Evolutionary Genetics & Adaptation
	Module 5: Mathematical Genetics

Module 1 – Genomes (MT)

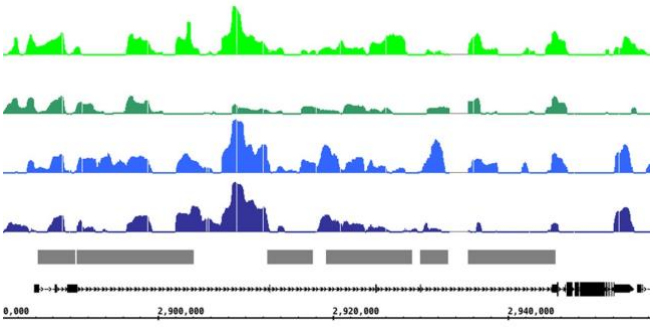
This module will explore how genomes are organised and maintained. We will start by exploring the control mechanisms that promote correct cell cycle progression and the accurate segregation of genes and chromosomes into daughter cells at cell division, centred on key cell cycle protein kinases, phosphatases and checkpoints.





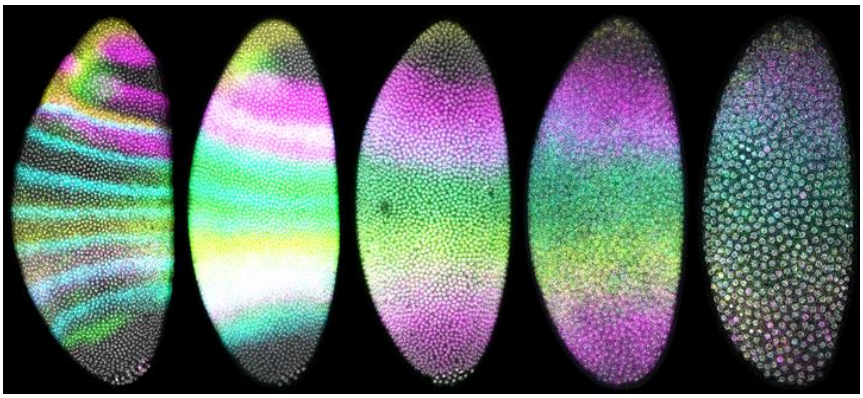
The module will then examine how genomes are sequenced, the sequence assembled and how sequence-based technologies, like Hi-C, reveal organisation at the chromosome level.

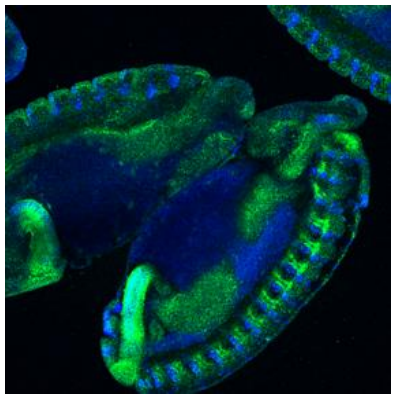
The make-up of genomes will be considered, from genes and their regulatory elements, to the importance of genetic variation and the non-coding genome and repeat DNAs. We will introduce the genomics approaches that underpin the functional analysis of genomes, including technologies for measuring gene expression, transcriptional activity and chromatin states.



The final lecture block will focus on the organisation of DNA and the proteins associated with it. The physicochemical regulation of chromatin structure and the contribution of liquid-liquid phase separation to genome and nuclear organisation will be examined. The origin of the eukaryotic nucleosome will be considered by examining the solutions arrived at in prokaryotes and archaea.

Module 2 - Early Development & Patterning: Genetic and Cellular Mechanisms (MT)





This module will cover how the early embryo develops from a fertilised egg to form the body plan. By comparing the body plan formation across phyla, you will be introduced to both conserved and divergent mechanisms of development.

You will learn about the key principles of embryonic development, taking examples from a range of early developmental events, such as cell fate determination, germline development, gastrulation, segmentation, and somitogenesis, in both invertebrate and vertebrate systems.

The aim is to use examples from a broad range of experimental systems that provide a detailed understanding of cell and molecular biology in action. This includes the intersection of gene regulatory networks and signalling in pattern formation, the role of cell polarity in cell fate determination and morphogenesis, how the acto-myosin cytoskeleton drives tissue morphogenesis and the role of mechanical forces in coordinating multi-tissue morphogenesis.

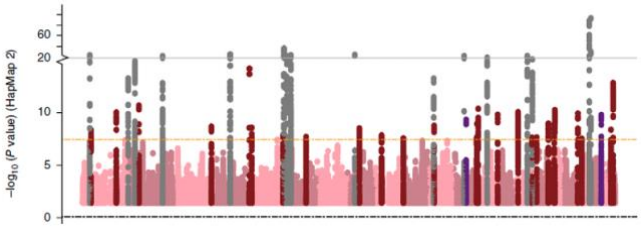
It will enable students to understand how emergent properties play out during embryogenesis: from the genetic control of cellular behaviours to the ways cellular collectives result in the shaping and folding of tissues. A comparative approach will highlight these essential principles of developmental biology.

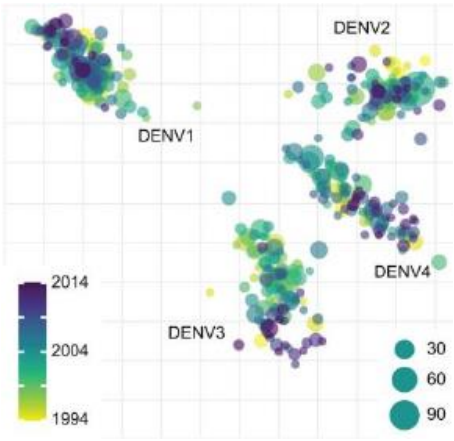
This is an inter-departmental module, with teaching shared by Genetics, PDN & Zoology.

Module 3 – Genetics of Health & Disease (LT)

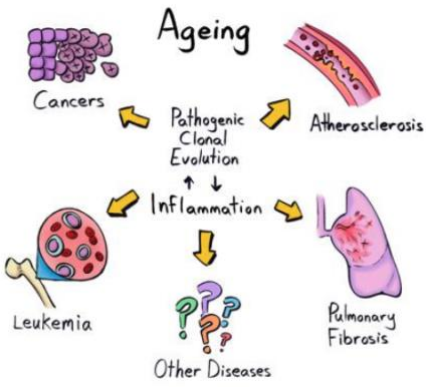
This module will be human-centric and, while it will look at some specific diseases, it will focus more on genetic approaches to understanding disease mechanisms and developing therapies, rather than on shallower coverage of an extensive list of diseases.

The module will look at human mutation, and the genetic approaches to both monogenic and multigenic diseases. Monogenic diseases include the growing number of rare diseases emerging from genome sequencing in the clinic. While individually rare, they are collectively common, and can be informative about the basic biology and disease mechanisms of more common diseases. Multigenic diseases include many common conditions with a genetic component and we will address approaches to identifying the causative genes, such as genome-wide association studies, and how they help us to understand the disease. Implications for personalised medicine are also discussed.





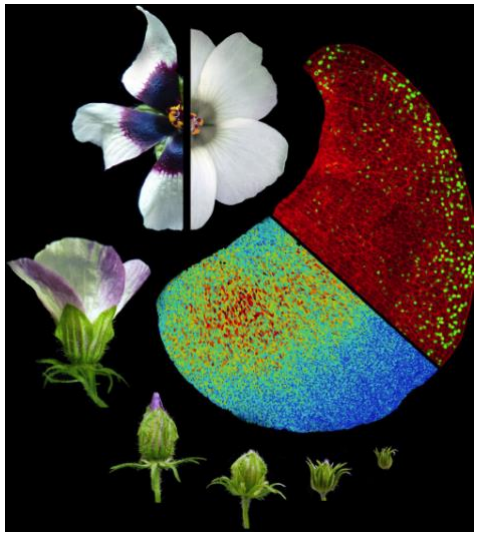
We will examine the genetics of infectious disease agents, including microbial genomics and phylogenetics, applied microbial genomics in clinical and public health, phylogeographic and phylodynamic models, pathogen epidemiology and antigenic evolution at scale, ancient DNA in study of pathogen evolution and transmission and sequencing approaches to understand microbiome diversity and function.



This module will also look at diseases for which genetic approaches have revealed much about their mechanisms, and potentially also therapies – neurodegenerative diseases (such as Parkinson's or Alzheimer's), mitochondrial disorders, genomic imprinting disorders and cancer.

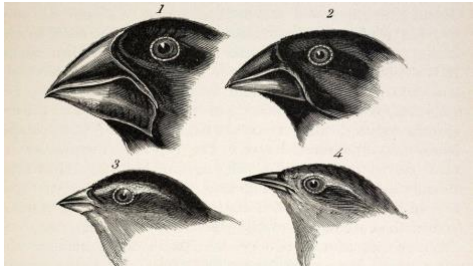
[This module is also available as a BBS Minor subject]

Module 4 - Evolutionary Genetics & Adaptation (LT)



Modern evolutionary theory has its roots in the union of Mendelian genetics with Darwin's theory of evolution, two of the great unifying themes of biology. This course will consider the process of evolution from a genetic perspective, exploring the central topics of natural selection, adaptation and genetic drift, and combining a variety of empirical and theoretical approaches. Alongside this, the course will explore how genomes themselves are shaped by selection, drift and their evolutionary history.

The first half of the module will explore the genetic basis of adaptation. Do we expect evolutionary change to involve few or many genes, and how might we go about identifying the genes underlying a particular trait? What kinds of genes control evolutionary changes in morphological traits? We look at the genes underlying convergent evolution as a way of understanding the predictability of evolutionary change. Genomic data contain a wealth of information about the history of populations and natural selection, and population genetics provides a framework to reconstruct these processes.



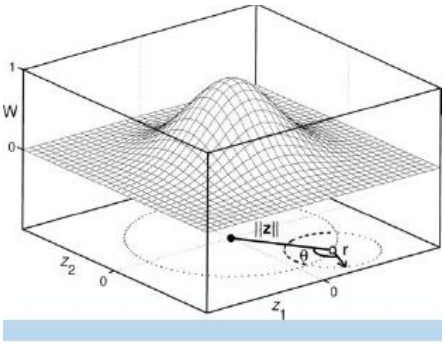
The second half of the module will look at the evolution of genomes and conflict within genomes. We will begin by examining the evolution of key features of genomes – sex chromosomes, introns, repetitive DNA, gene expression and mutation rates.

We will finish by considering one of the conundrums of evolutionary biology – why some species reproduce sexually – from a theoretical and empirical perspective.

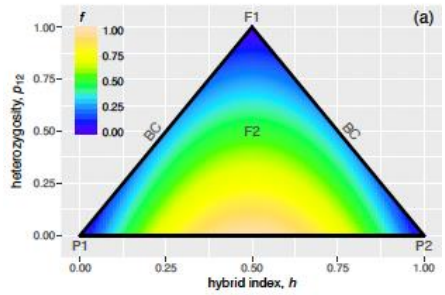
This is an inter-departmental module, with teaching shared by Genetics & Zoology.
[This Module is also available as a BBS Minor subject]

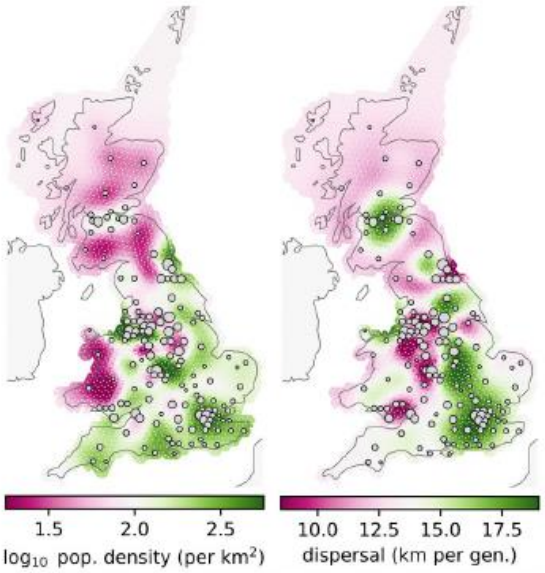
Module 5 – Mathematical Genetics (LT)

The aim of this module will be to give students a thorough grounding in mathematical approaches to the study of genetics. Emphasis will be placed on fundamental principles, equipping students with a deeper understanding of the various roles of mathematics in the field, and the ability to understand, and even develop, the next generation of tools.



The material covered will include the nature and uses of mathematical models, including latent variable models, and statistical methods of inference. The course will also cover topics relevant to particular areas of genetics, including evolutionary, developmental, and biophysical genetics, as well as other subfields that link genotype to phenotype. These topics will include





mathematical population genetics (including the coalescent approach, which underpins inferences from genomic sequence data); quantitative genetics (the inheritance, architecture and evolution of complex and continuously-varying traits); dimensionality reduction approaches, which are essential to understanding large data sets (e.g. single-cell data), and dynamical systems modelling of gene regulatory networks.

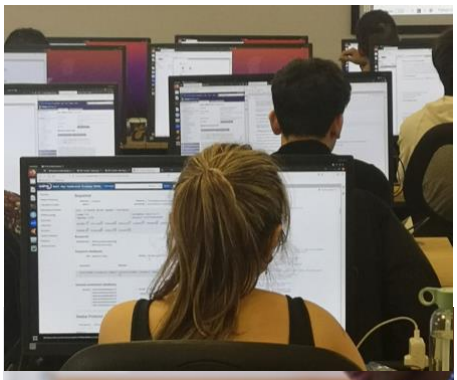
[NST2GN and NST2BBS (Genetics) students opting to take the Mathematical Genetics module will need to have the required computational and mathematical skills. The expectation is that NST students selecting it will have taken IB MCB. However, any student wishing to select the Mathematical Genetics module, who has not taken MCB (including MedST and VetST students), will be considered on a case-by-case basis.]

‘Extras’

Social Aspects of Genetics (SAGs) - a series of interactive discussions, with invited speakers from the Sanger Institute, Addenbrooke’s, and elsewhere. Topics include medical ethics (e.g. issues surrounding gene therapy, genome sequencing and over-the-counter DNA testing kits), bioethics (e.g. genome editing technologies, such as CRISPR), antibiotic resistance, plant GMOs, scientific publishing & “open research”, and genetics & race.

Michaelmas Term Information Sessions - will cover study skills (including essay writing workshops and information on plagiarism and how to avoid it). Introductions to bioinformatics and to statistics will be run, along with briefings on coursework preparation and the end-of-year examinations. In addition, there will be sessions outlining the PhD application process, and on careers in genetics.

Journal Sessions - are held for each Module, in which students learn to read, understand and criticise papers from the primary scientific literature.



Problem-solving/Data-handling sessions - students work in groups solving genetics problems or interpreting experimental data. This forms vital practice for the exams, and indeed for any future career in a lab.

Computational Practical Training - for those interested in delving further into programming and bioinformatics there will be opportunities during the course and through the research project.

Meetings with your Adviser - during the Michaelmas term you are encouraged to arrange weekly meetings with your assigned Adviser, who will answer any queries you have about the course and its organisation and will help sort out any problems that arise during the year.

Seminars - the Department runs two main seminar series, which Part IIs are encouraged to attend. One is given by external speakers; in the other current Postgraduate students give a brief lunchtime presentation on their research.

Supervisions - Genetics lecturers will provide a list of times when they are available to give supervisions, together with possible essay titles and topics for discussion. We encourage you to submit essays to lecturers, who will provide you with feedback.

Revision Seminars – there is no formal teaching in the Easter Term, but revision seminars are organised for each module, to allow you to ask questions about the aspects you don't feel you have understood, and to help with your preparation for the exams.

The Part II Examination

The examination for Genetics Part II (NST2GN) consists of five written papers, and a research project. There is also a brief oral examination.

Each module in the course will be examined by a separate 3 hr closed book written paper in the final examination, so you can expect questions on Module 1 to be in Paper 1 and so on. Each paper will include both essay-based questions and questions designed to assess the skills acquired in the data handling/ problem-solving components of the course and the journal sessions.

There is one additional paper, the Integrated Paper. This is a 2 hr closed book paper and will contain a mix of broad-based questions designed to test your ability to integrate knowledge from across the course, as a whole.

If you are taking **NST Part II Genetics**, the current weightings of each part of the examination are:

Four written Papers (each mapping to one Genetics module, 16% x 4)	64%
Integrated Paper	10%
Research Project (research project & dissertation) *See the following pages for information about the project*	26%

If you are taking Genetics as **BBS Part II major subject** the current weightings of each part of the examination are:

Four written Papers (each mapping to one Genetics module)	64%
Minor Subject	16%
Dissertation *See page 17 for information about the dissertation*	20%

The Research Project

In the Lent Term each Part II Genetics student carries out an individual research project. This forms an important part of the course and allows you to engage in your own research work within an established group in the Department. It gives you an opportunity to work alongside graduate students and post-doctoral scientists who are carrying out up-to-date work in the field, and to become familiar with the atmosphere of an experimental laboratory.

Each student selects a project from a list of options suggested by members of staff. Projects are chosen during October/ November, which gives plenty of time to plan them before the beginning of Lent Term.

You will be asked to write a review of the scientific literature in your chosen field.

Then your actual research will start at the beginning of the Lent term. Your findings are written up and the report handed in at the beginning of the Easter vacation.

As well as providing an exciting opportunity for you to demonstrate initiative and ability, the project gives you some idea of what research is really like.

Project Presentations
At the end of Lent Term, all students give a short oral presentation on their research project to the rest of the class, and a few of the lecturers. A chance to try to lecture better than the lecturers!

In the time available, exciting results can emerge: some projects have evolved into PhDs for the student concerned, and others have **contributed to published scientific papers**. For example -

... Jennifer P. Hoang [Part II 2022/23], Rookmini Mukhopadhyay [Part II 2023/24] contributed to:
Viral diversity influences T-cell responses to enteric human adenoviruses F40 and F41: Holly M. Craven, **Jennifer P. Hoang**, **Rookmini Mukhopadhyay**, Arnold W. Lambisia, Benjamin A.C. Krishna, Benjamin J. Ravenhill, Charles N. Agoti, Charlotte J. Houldcroft. **Virus Evolution,** (2026) 12 (1), veaf098 doi: https://doi.org/10.1093/ve/veaf098
&

Adenovirus-Specific T Cells in Adults Are Frequent, Cross-Reactive to Common Childhood Adenovirus Infections and Boosted by Adenovirus-Vectored Vaccines: **Rookmini Mukhopadhyay**, Arnold W. Lambisia, **Jennifer P. Hoang,** Benjamin J. Ravenhill, Charles N. Agoti, Benjamin A. Krishna, Charlotte J. Houldcroft. **J.Med.Virology** (2025) 97(2) e70222 doi: https://doi.org/10.1002/jmv.70222

… Adam Gibbon [summer vacation student & Part II 2023/24] contributed to:
Analysis of 30 chromosome-level Drosophila genome assemblies reveals dynamic evolution of centromeric satellite repeats: Daniel Gebert, Amir D. Hay, Jennifer P. Hoang, **Adam E. Gibbon**, Ian R. Henderson and Felipe Karam Teixeira. **Genome Biology** (2025) 26(63) doi: 10.1186/s13059-025-03527-4

… Elizabeth Torley [Part II 2021/22], Phoebe Blair [Part II 2020/21] and Frankjel Frometa Hernandez [Part II 2023/24] contributed to:
Destabilisation of bam transcripts terminates the mitotic phase of Drosophila female germline differentiation: Tamsin J Samuels , **Elizabeth J Torley**, Valeriia Nadmitova , Emily L Naden, **Phoebe E Blair**, **Frankjel A Frometa Hernandez**, Felipe Karam Teixeira. **Developmen**t (2025) 152(5) doi: 10.1242/dev.204405

… Sarah Murphy [Part II 2022/23] contributed to:
Tolerance thresholds underlie responses to DNA damage during germline development: Gloria Jansen, Daniel Gilbert, Tharini Ravindra Kumar, Emily Simmons, **Sarah Murphy**, Felipe Karam Teixeira. **Genes & Development** (2024) 38(13-14) 631 doi: 10.1101/gad.351701.124

… Mirte Kuijpers [summer vacation student and Part II 2020/21] contributed to:
Martiniano R, Haber M, Almarri MA, Mattiangeli V, **Kuijpers MCM**, Chamel B, Breslin EM, Littleton J, Almahari S, Aloraifi F, Bradley DG, Lombard P, Durbin R : Ancient genomes illuminate Eastern Arabian population history and adaptation against malaria. **Cell Genom** (2024) doi: 10.1016/j.xgen.2024.100507

… Carol Sun [summer vacation student & Part II 2019/20] and Katy Grobicki (Part II 2017/18 & subsequent PhD student] contributed to:
Systematic analysis of noncanonical ribosomal protein paralogs does not provide evidence for specialized functions in *Drosophila*: Katarina Z A Grobicki , Daniel Gebert, Carol Sun , Felipe Karam Teixeira. **PNAS** (2025) 122(49)e2506642122. doi: 10.1073/pnas.2506642122

… Eve Ainscough [Part II 2018/19] contributed to :
Elmer JL, Hay AD, Kessler NJ, Bertozzi TM, **Ainscough EAC** & Ferguson-Smith AC : Genomic properties of variably methylated retrotransposons in mouse. **Mob DNA** (2021) 12(1): 6 doi: 10.1186/s13100-021-00235-1

Examples of projects offered:

- The role of CTCF in imprinted domains.
- Imprinted gene products in lactation and postnatal resource control.
- Maintenance and establishment of DNA methylation at variably methylated regions in early embryos.

- A combined phylogenetic and epigenetic approach to understand domestication of transposable elements in the human genome.
- Control of terminal differentiation in the Drosophila germline.
- Exploring the role of mechanical signals in the specification of the gastrula organizer.
- Connectomics approach to study the role of an unusual pair of neurons in Drosophila learning circuitry.
- Quantitative patterning roles of Prd and Ftz in the Drosophila pair-rule gene network.
- Endoplasmic reticulum (ER) and the axon degeneration disease, hereditary spastic paraplegia.
- Solving the mystery of microtubule organisation in epithelial cell.
- Mechanisms at the interface between cell polarity and the cell cycle.
- TOPBP1 in mitosis.
- Molecular dynamics simulations of protein binding to supercoiled DNA.
- Estimation of mutation rates in Malawi cichlids and small ermine moths.
- Characterising respiratory adenovirus diversity with a novel Nanopore sequencing method.
- The genetic basis of virus resistance in Drosophila.
- Dengue virus evolution.
- Inferring stem cell dynamics from the shape of a single-cell genealogy.
- The long-term consequences of hybridization, or When can we fix heterosis?
- Biofilm Formation in E. coli: Investigating the Tryptophanase-Related Mechanisms.
- Activity of urinary extracellular vesicles against E. coli biofilms.
- Understanding the evolution of flower patterning using transcriptomic approaches.
- Role of flavonols during petal development.

The BBS Dissertation

BBS students will have the chance to select a dissertation topic from a list circulated early in the Michaelmas term. All BBS students will be asked to give a short oral presentation on their dissertation research to the rest of the Genetics class and a few lecturers at the end of the Lent Term. Past topics have included:

- Can we assign a function to 80% of the DNA in the human genome?
- The biology of CRISPR/CAS systems and their uses in eukaryotic genome engineering.
- How can genomic data be used to understand cancer evolution and to assist with cancer therapy?
- How does a cell make a decision to divide – or stop dividing?
- How have bdelloid rotifers avoided sex for so long?
- Discuss the concepts presented in C H Waddington's 1942 paper in *Nature* 'Canalisation of development and the inheritance of acquired characteristics'.
- Transgenerational epigenetic inheritance in mammals - fact or fiction?
- Many human cancers are aneuploid. Yet aneuploidy has detrimental effects on human development and has been shown to reduce cellular fitness : Consider this conundrum.
- Why do endosymbiotic bacteria have small genomes?

- Cell and gene therapy – the future of human monogenic disorders.
- Have regulatory changes been more important for the evolution and divergence of species than changes in protein coding sequence?
- Discuss recent developments in the mechanistic understanding of cell size control.
- Transposable elements and their impact on human health - new opportunities in the era of large scale human genome sequencing.
- Can the bacterial endosymbiont Wolbachia eliminate vector-borne disease?
- Safeguarding genome integrity: DNA damage and repair in heterochromatic domains of eukaryotic genomes.
- Genetic Mechanisms of pattern formation on the surface of plants and animals.
- What can single cell 'omics approaches really tell us about biology?
- Understanding the ability for chikungunya virus to persist endemically in populations.
- How important was the impact of archaic admixture on the human genome?
- How are important are mutations of large effect for adaptation by natural selection?
- What has experimental evolution taught us about how new species arise?

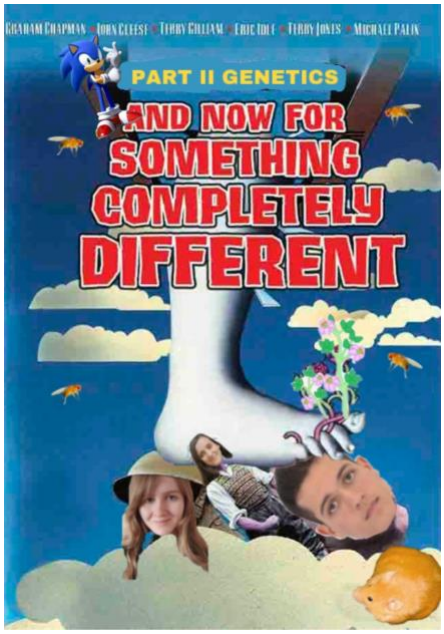
Social Aspects of Life in the Department

(RIG day 2024)

Research in Genetics Day
This one-day review of research in the Genetics Department takes place at the end of the Michaelmas Term. This informal meeting is an excellent way to appreciate who does what within the Department. Part II students are encouraged to attend.

The Christmas Party and Student Panto
At the end of the Michaelmas Term, the Part IIs dazzle the department, traditionally with a Panto. This could be your chance to not only demonstrate your thespian skills, but also to exact revenge on the academic staff who have tortured you in lectures! This Department can, shall we say, boast several members of staff who can easily be represented as compelling pantomime characters – and they love it!

(Posters from the 21/22, 22/23 and 24/25 Part II Class Pantos; Christmas “Labathon” group photo; Pumkin carving at the Halloween Happy Hour 2024.)



Happy Hour
Once a month, departmental Lab Groups take turns to host invite our popular Happy Hours. All from the department are invited for drinks and snacks.

The Summer Garden Party
After the exam results are announced we hold a Summer Garden Party; a chance to relax and celebrate with the rest of the Department once the year’s hard work is over with food and drinks.

The Department also has an Events Committee, which put on events across the year - students are welcome to join.

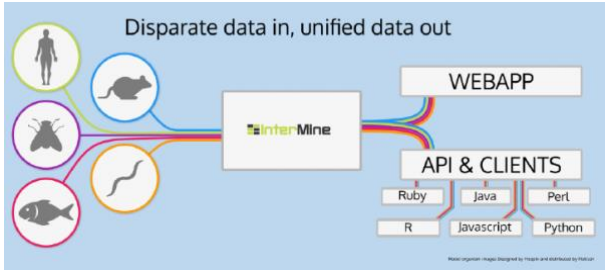
Research in the Department of Genetics

The range of research subjects in the Genetics Department is very broad, but it can be roughly divided into the 'themes' below. Of course, many Groups fit more than one 'theme'. This breadth benefits students in several ways. First, it means that the Department is well balanced between whole-organism and molecular approaches. Second, for those wishing to go on to research, there will almost certainly be someone with useful contacts, to help you get into almost any branch of genetic research. Each research group has its own web page, with more details about their work, accessed from: http://www.gen.cam.ac.uk/research-groups.

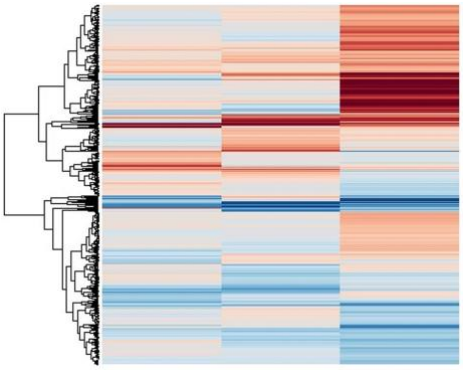
Where researchers are located away from the main Genetics building their location is indicated.

Functional Genomics:

Employing high-throughput sequencing, bioinformatics, and genome-wide techniques to analyse genomic processes. Exploring how epigenetic modifications to DNA and chromatin influence genome function, stem cell properties, and transgenerational inheritance.



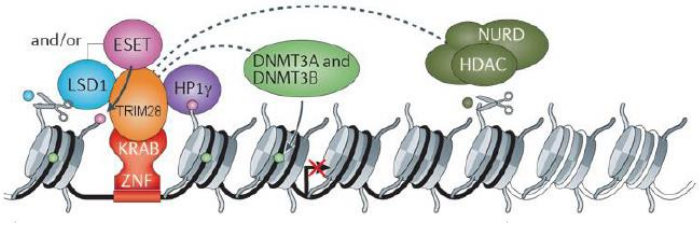
Prof Steve Russell. F is for Fruit Fly and Steve is a big fan. His is one of several groups using *Drosophila* as a model in research. Steve's group is studying the function of the Sox family of transcriptional regulators during embryonic development with a particular focus on the role the proteins play in the formation of the CNS. Along with classical genetics and developmental biology, they are utilising modern functional genomics and proteomics approaches. Recently they have been using clever genetic and biochemical approaches to better understand effective insecticide design.

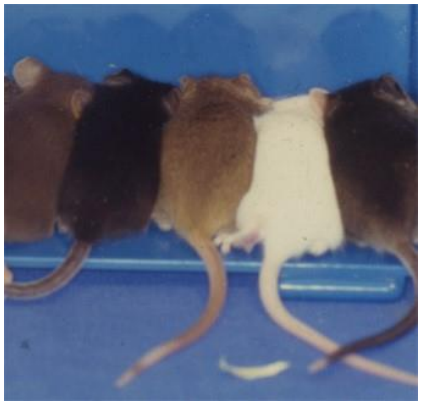


Prof Gos Micklem. Gos works in the field of integrative genomics – applying high throughput experimental methods and using bioinformatics to solve real world problems. Some work focuses on developing new tools and providing community resources (such as their data warehouse system InterMine). His research ranges across a number of fields and includes *de novo* genome sequencing and annotation to obtain insights into gene function and evolution, genomic studies of parasite action, cancer biology, and synthetic biology.

Dr Ritwick Sawarkar (MRC Toxicology Unit). Ritwick is interested in how cells survive stressful conditions through their transcriptional response. This is important not only in the context of cellular exposure to environmental stress and toxins, but also to small-molecule therapeutics.

Prof Anne Ferguson-Smith FRS, FMedSci. Using mouse genetic models, the Ferguson-Smith lab studies the genetic and epigenetic control of developmental processes including stem cells, and the epigenetic control of genome function. The research combines both experimental and bioinformatics approaches to understand the link between genome and epigenome and the impact that this has on normal and abnormal development and physiology in tissues and in the whole organism.





Prof Michael Boemo (Path/GN). Mike's group uses computational approaches to study DNA replication and repair. They develop high performance mathematical modelling methods and AI models that analyse large genomic sequencing datasets. Their software is being used by groups around the world.

Prof Rosana Collepardo (Chemistry/GN). Rosana's research focuses on understanding DNA packaging inside cells using approaches that bridge genetics, theoretical chemistry and physics. She develops and applies multi-scale computational models to investigate the structure of the genome at the nanoscale level. Their recent work has shown that nucleosomes are diverse and plastic and chromatin is liquid-like!

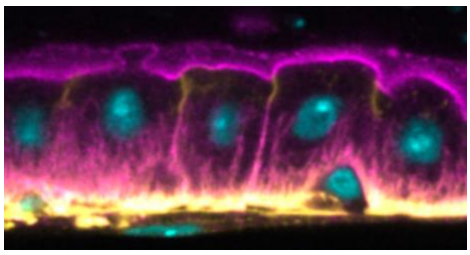
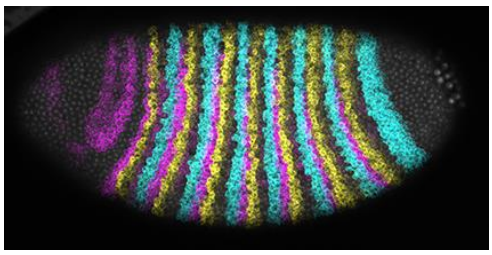
This theme also includes these groups: Ahringer, Durbin, Karam Teixeira, Rosello-Diez, Sawarkar.

Developmental Genetics

Using model organisms like Drosophila, C. elegans, mice, and plants to study cell polarity, gene regulation, and pattern formation.

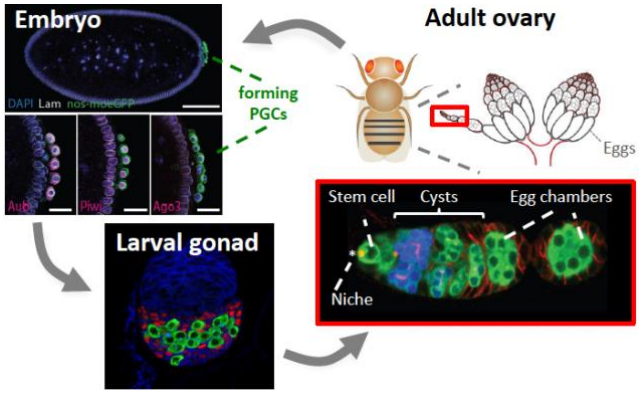
Prof Julie Ahringer FRS, FMedSci (Gurdon Institute). Julie is interested in how chromatin regulation plays a central role in transcriptional control and genome organisation, because dysregulation is implicated in human disease. Her group uses the power of functional genetics and genomics in the nematode *C. elegans* to address fundamental questions by analysing epigenetic state and function in wild-type and mutant animals and tissues. *C. elegans* is an excellent system for studies of chromatin function due to its small well-

annotated genome, powerful RNAi technology, and rich resource of chromatin mutants. Another reason that Julie and her colleagues study *C. elegans* is because it's beautiful!

Prof Ben Steventon. Ben's research interest is in comparative developmental dynamics. He wants to know how, during embryo development, multiple tissues take shape in a highly coordinated manner to build the final body plan. Ben likes to use a musical analogy "Think of an orchestra without a conductor. Do players listen out for each other to keep in tempo? How does one section of the orchestra communicate with another?" His group is studying this using several model systems, but their favourite is the Zebrafish because, as everyone knows, Zebrafish Rock!

Prof Felipe Karam Teixeira. Felipe's interest is the development of the germline, the 'immortal' cell lineage that provides the continuity of life. In particular, he is interested in the genetic and molecular mechanisms controlling germline stem cell behaviour and protecting totipotency, using the *Drosophila* ovary as a model system. Half of his group work on gene expression regulation during stem cell self-renewal and differentiation, while half work on mobile elements and genome stability. Felipe himself is functionally and structurally very stable.



Dr Erik Clark. Erik is fascinated by developmental patterning systems and their evolution. Most of his research is on various aspects of anteroposterior patterning in the *Drosophila* blastoderm, but is he is also interested in arthropod evo-devo and vertebrate somitogenesis. His groups uses interdisciplinary approaches best summed up in the slogan "microscopy, mutants and modelling."

Prof Alberto Rosello-Diez (PDN/GN). Alberto is looking into how organs "know" how much they must grow in order to attain and maintain species-specific body proportions. His group studies genetic models (transgenic mice and chickens) using classic analyses alongside state-of-the-art imaging and "omics" techniques to study organ development & regeneration.

Dr Edwige Moyroud (The Sainsbury Laboratory). Edwige's group investigates the mechanisms of pattern formation on the petals of flowering plants and is known as "Team Hibiscus" because of their fascination with this plant and its beautiful bullseye pigmentation patterns. These patterns play crucial roles in both pollinator attraction and in pollen

protection against UV damage. They also represent striking examples of evolutionary diversification by natural selection. Her group combines a range of genetics and developmental biology approaches with novel imaging, modelling and phylogenomic tools.

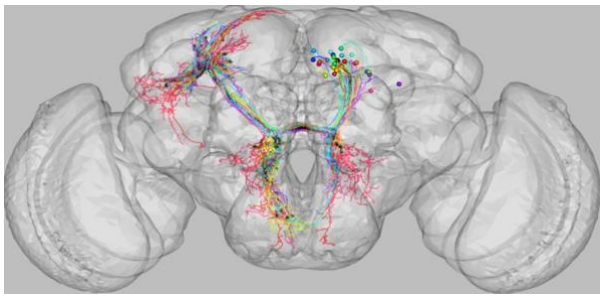
This theme also includes these groups: Ferguson-Smith, Russell

Cell Biology

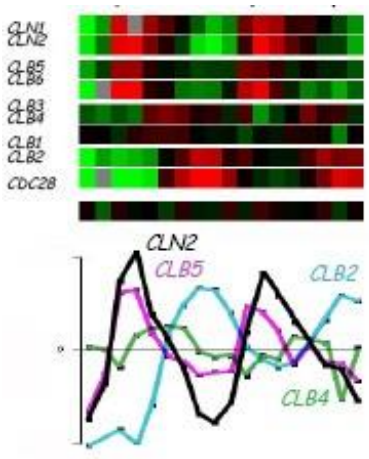
Investigating cell division, polarity, cytoskeleton, membranes and neurodegeneration in humans, yeast and Drosophila.

Prof Daniel St Johnston FRS, FMedSci (Gurdon Institute). Daniel makes fruit fly larvae with no heads or no abdomens, or in some cases, two heads or two abdomens. He studies the mechanisms involved in localisation in the egg of maternal determinants such as bicoid RNA, which control embryonic pattern formation. He uses *Drosophila* as a model system to investigate intracellular transport and the origin of anterior-posterior polarity. Daniel himself has a normal complement of body parts.

Prof Cahir O'Kane. Cahir studies how neurons work and how they go wrong during neurodegeneration in *Drosophila*. Of particular interest are the processes that organise and traffic membranes, both pre-and post-synaptically. At this level, flies are about as smart as we are.



Prof Marisa Segal. Marisa's group uses the yeast *S. cerevisiae* to explore the mechanisms coupling mitotic spindle orientation with cell polarity, processes critical for the fidelity of chromosomal segregation and cell division. The principles emerging from these studies can be extended to learn how spindle orientation is controlled throughout metazoan development to generate cell diversity.



Dr Marco Geymonat. Marco is also a big fan of the yeast *S.cerevisiae* and is using genetics, biochemistry and microscopy to study cell polarity, spindle orientation and cell cycle progression.

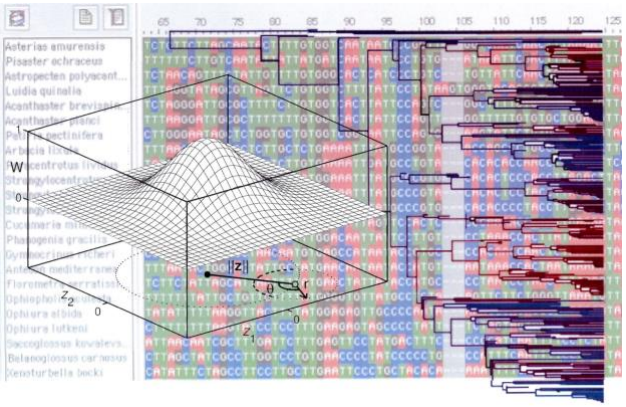
This theme also includes these groups: Boemo, Collepardo, Hocher, Sawarkar,

Evolutionary & Computational Genetics

Combining experimental and computational approaches to study genomes and evolution.

Prof Frank Jiggins. Using insects as a model system, Frank's Lab is studying the evolution of hosts and parasites. A combination of population, quantitative and molecular genetics is being used to address the genes that cause variation in susceptibility to infection, the

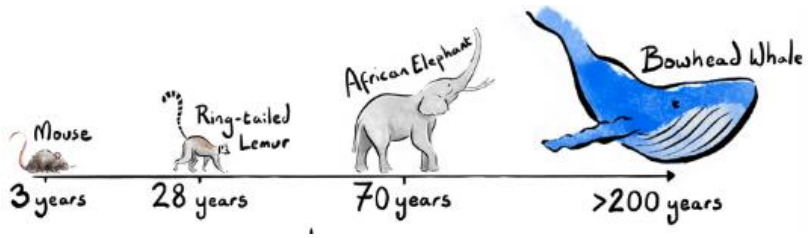
evolutionary processes that maintain this variation in populations and how coevolution with parasites has shaped the insect immune system.



Prof John Welch. John's research focuses on the processes that shape DNA sequence variation within and between populations. Ongoing research projects involve quantifying the contribution of natural selection to genomic change, inferring specific selection pressures that were faced by natural populations, and identifying the general conditions that promote or hinder an adaptive response.

Prof Aylwyn Scally. Aylwyn's research focuses on the evolution of populations and species, using computational analyses of large-scale genome sequence data. His particular interest is in human and primate evolution, but the methods and approaches involved in evolutionary genomics are applicable to organisms across the tree of life.

Prof Richard Durbin FRS. The focus of the Durbin group is sequence-based analysis of genetic variation and genome evolution. Their computational research projects encompass a broad range of organisms, including ancient and modern human DNA samples, induced pluripotent stem cells and cichlid fishes. Richard can't get enough genome sequences so is leading the University's collaboration with the *Darwin Tree of Life* project, which is sequencing thousands of species from the British Isles.



Dr Alex Cagan. Alex and his group study somatic evolution in diverse species across the tree of life to gain insights into ageing, cancer and reproductive health. In his spare time Alex relaxes as a science illustrator.

Dr Renske Vroomens (The Sainsbury Laboratory). Renske is trying to identify general principles of evolution that are shared between plants and animals as well as interesting and informative differences. To do this she uses computational models to study the evolution of plant organs, simulating thousands of years of evolution in days or weeks and storing a perfect "fossil record" of all the changes.

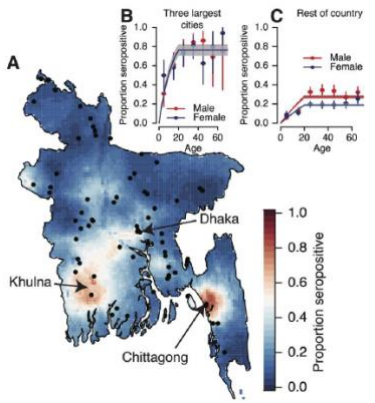
Dr Heather Machdo (Path/GN). Heather studies the somatic evolution of the immune system. Using cutting edge techniques in single cell multiomics and phylogenetic lineage tracing she aims to better understand cancer immunology and immune ageing.

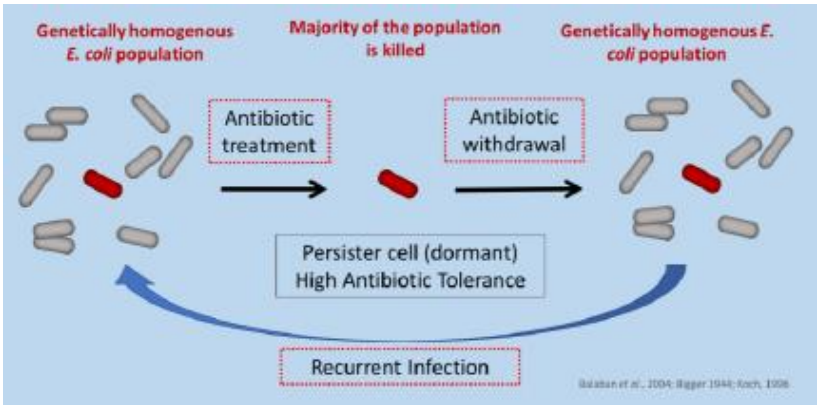
Dr Antoine Hocher (GN). Antoine's research focus is on the discovery and invention of DNA-binding proteins and DNA-mimicking in the context of or applied to disease. The Hocher group investigates these topics by combining computational biology, phylogenetics, molecular biology and directed evolution.

This theme also includes these groups: Ahringer, Baez-Ortega, Boemo, Collepardo, Karam Teixeira, Moyroud, Rosello-Diez

Pathogen Genetics & Dynamics

Studying how infectious agents spread, evolve, and interact with hosts, aiming to improve disease prevention and treatment.





Professor Henrik Salje. Henrik's research is on applied public health research, especially with regards to the spread of infectious pathogens. His work sits at the interface of mathematical modelling, genetics, population biology, big data, public health and field-based epidemiology. His group has recently published findings highlighting the age-specific mortality and immunity patterns of SARS-CoV-2.

Dr Charlotte Houldcroft. Charlotte is focussed on understanding how the genetic diversity of DNA viruses impacts human health and how ancient evolutionary processes have shaped the viral genomes circulating today. Charlotte's work on herpes virus genomes from ancient DNA samples suggest that the virus became widespread with Bronze age migrations into Europe and possibly with the emergence of kissing!

Prof Kate Baker. Kate studies how pathogen genome variation and evolutionary processes impacts their epidemiology and control. She has a particular interest in the dynamics of the accessory genome in bacterial populations, including antimicrobial resistance.

Dr Ash Zarkan. Ash is seeking to understand the mechanisms of biofilm and persister formation in E. coli. The goal is to develop new therapies to inhibit E. coli biofilms and persisters, thereby reduce pathogenicity, improve antibiotic effectiveness and reduce recurrency in UTIs.

Also includes these groups: Hocher, Jiggins, Micklem, Welch

Beyond Part II

Part II Genetics offers a challenging, rewarding and socially enjoyable course, which combines whole organism biology and molecular studies effectively to provide a step towards a successful career.

Many in the Part II class will progress to PhD positions in Cambridge and elsewhere. This is normally the best option for an eventual career in either pure research (e.g. in a university or research institute), or industrial research (e.g. in a biotechnology or pharmaceutical company). There are prospects for research positions in both 'pure' areas such as cell biology, genome analysis, evolutionary and population biology, and more 'applied' areas such as agricultural and medical genetics, biotechnology, and genetic applications to environmental problems. Where funding is tight a background in genetics may give prospective candidates an edge. A PhD might for example lead on to a career in bench science, academic or industrial research, science administration and management, working in an advisory capacity, or publishing and disseminating scientific information.

Employment prospects are good for Cambridge graduates in general. Part II Genetics provides an excellent training also for those not wishing to continue in 'front-line' science. Many employers are realising that they require people with a good background knowledge of genetics and a broad scientific training, even for jobs that do not involve bench science. Therefore, there are Part II Geneticists doing well in traditional publishing, in the City, in the law, even accountancy!

Genetics is a booming subject that offers a wider range of job opportunities than many other areas of biology

Former Part II and PhD students from this department now hold significant scientific positions in the UK and world-wide: Oxford, Cambridge, the USA (Yale, California), and the Pacific rim (Singapore and Papua New Guinea). They often work as research group leaders for companies such as Unilever, AstraZeneca, Novartis and GlaxoSmithKline. Some have joined Cambridge area 'Start Ups'. Other science-related destinations have included publishing (e.g. Benjamin Lewin, who founded the important journal, *'Cell'*) and venture capital consultancy.

Part III Systems Biology

For those interested in the Part III Systems Biology course, Part II Genetics offers an ideal platform by providing a comprehensive grounding in the basic methods underpinning genomics as well as an introduction to modelling approaches from a developmental biology perspective. More information is available here: NST Part III Systems Biology

Feedback from recent former Part II students

Jenny Yang (Part II 2022/23 MedST)

6* reasons why Genetics is the best Part II subject you can choose:
1. Organisation / timetabling: many thanks to our incredible Part II administrator, you don't have to suffer consecutive hours of lectures (ahem, PDN) or 7 hour gaps between lectures (ahem, Path). Instead, a 1 hour break between 9am and 11am lectures is the perfect amount of time to go grab a free tea / coffee from the tea room and sit around and chat (or work). (The excuse that you're not a 'morning person' doesn't work as you'll be forced to become one for your second-year exams.)
2. Part II Teaching Room: in no other subject will you get a room that is dedicated for you – a spacious room with charging ports, great lighting, good temperature control and actual desks and comfy chairs for all your lectures and other teachings means that you don't have to suffer uncomfortable wooden lecture hall seats where there isn't enough space to fit your laptop / page to write notes.
3. No module choices (great if you're bad at making decisions), which also means you always have the same peers, which means you'll actually talk to each other (due to the Part II room as a communal space), which means you will make new friends! (vs different peers for each module and everyone just goes in for the lecture and immediately leaves after with no conversation whatsoever). Evidence: can any other Part II subject class put together such a successful pantomime at the end of Michaelmas term (when no one has any experience acting in or organising pantomimes)?
4. Lectures and supervisions: worried about having to organise your own supos in 3rd year? Heard horror stories from people who only had 2 supos in their entire 3rd year? Fear not! All lecturers provide sign up sheets for supervision times after their block which saves you having to be awkwardly proactive and emailing them to ask for supos. They're also really chill about you sending in essays - no harsh inflexible deadlines (which also corresponds to them returning feedback… but that's the same for anywhere).
5. Supplementary teachings to lectures: journal clubs which fit in with the topics from lectures are really helpful to guide you on how to read and extract information from papers, and discussions in "Social Aspects of Genetics" (SAG) sessions are also really engaging and exciting; combined, this makes studying the course really interesting!
6. Wide range of project choices: there's a wide range of wet and dry lab projects on offer each year, from opportunities to work with a wide range of model organisms and experimental techniques to entirely computational modelling or data analysis, there's something for everyone!
*This list was originally intended to be "5 reasons why…", but there's just too much to say!

Ala Maksymiuk (Part II 2021/22, NST)

I really enjoyed Genetics because it challenged my ways of thinking about science and showed how it can be approached from different angles (e.g. experiment-based, systematic or evolutionary). What's more, I recommend this course for both the fans of computational and experimental biology as you can choose a project that suits you and you are not forced to use the techniques you don't enjoy.

Ujjawal Kumar (Part II 2020/21, MedST)

I thoroughly enjoyed my year with the Genetics Department! I had always been interested in genetics and it was a subject I had wanted to study since first year, but as a medical student, I was a bit anxious about how I would find certain aspects that particularly the NatScis had covered the basics of already. This however wasn't an issue in the end, as everyone in the department, from lecturers, to graduate students, to the admin team were so supportive and all did what they could to help us feel prepared and ensure we didn't miss out in any way. They arranged catch up supervisions and teaching sessions, as well as providing us with prerequisite course materials over the summer to familiarise ourselves so we didn't feel disadvantaged. I loved my project, and the opportunity to work within a research group in the department, and especially coming up with a research project that I was interested in and passionate about. I have continued to work with the group, and my work has spawned multiple opportunities for me to present my work at conferences ranging from the University to international conferences, where I have been honoured to receive prizes at each level for the best presentation, and this wouldn't have been possible without the support and guidance of my supervisor and the team at the department! I also particularly enjoyed the small group supervisions, with the lecturers themselves, which were a great place to discuss the lecture content and ideas for essays and research.

Some Eminent Past Part IIs

[And note – not all of them got Firsts!]

Dr Rob Bensted-Smith OBE
A biodiversity conservation and international development expert. Until 2002, the Director of the Charles Darwin Research Centre and Chief Conservation Officer on the Galapagos Islands. Then based in the Americas, Caribbean, and eastern Africa working with governments, NGOs, communities & businesses. Currently Executive Director at *Talking Transformation Ltd* here in Cambridge.

Professor Allan Bradley FRS
Former Director of the Wellcome Trust Sanger Institute at Hinxton. His PhD studies in Martin Evans laboratory in the Department laid the foundation for making knockout mice. In 2023 he launched *T-Therapeutics* to deliver TCR cancer therapeutics.

Professor Brian Charlesworth FRSE FRS
Awarded the Darwin Medal of the Royal Society in 2000 and the Thomas Hunt Morgan Medal of the Genetics Society of America in 2015. for his work in evolutionary genetics. Respected author, based at the University of Edinburgh.

Professor Enrico Coen CBE FRS
Group Leader and former Head of Cell and Developmental Biology at the John Innes Centre, Norwich, and author of 'The Art of Genes: How organisms make themselves'. Awarded the Darwin Medal in 2004 for 'ground-breaking discoveries about the control of flower development'.

Professor Edith Heard CMG FRS MAE
Her research group is best known for its studies on mammalian X inactivation. From 2010-2018 was Director of the Genetics & Developmental Biology department at the Curie Institute Paris. In 2019, Director General of the European Molecular Biology Laboratory (EMBO). She is also a member of the science council of the WHO. She became CEO of the Francis Crick Institute in London in 2025.

Benjamin Lewin
Founder of the highly significant journal, '*Cell*', and writer of the standard textbook in genetics, 'Genes XI'.

Professor Mary Lyon FRS
Best known for her discovery of X chromosome inactivation. Since 2015 *The Genetics Society* has awarded the Mary Lyon Medal in her honour.

Dame Ottoline Leyser DBE FRS
Ottoline was founding head of the Sainsbury Laboratory in Cambridge (2013-2020). From 2020-2025 she was CEO of UK Research & Innovation (UKRI). She was elected Regius Professor of Botany at Cambridge. Ottoline was awarded a DBE in the 2017 New Year's Honours List for services to Plant Science, Science in Society and Equality and Diversity in Science.

Professor Rob Martienssen FRS
Based at Cold Spring Harbor Laboratory. Responsible for the *Arabidopsis thaliana* genome sequence, the first plant genome to be sequenced. His research explains the effects on plants of the "jumping genes" first reported by Barbara McClintock.

Mr Anthony Odgers
As the University's Chief Financial Officer, Anthony has oversight of all the institution's assets, including Cambridge University Press, Cambridge Assessment, the Cambridge University Endowment Fund and the University's technology transfer through Cambridge Enterprise. Before taking up this post, he had more than twenty years banking experience.

Professor Veronica Van Heyningen CBE FRS FRSE FMedSci FRSB
Former head of the MRC Human Genetics Unit in Edinburgh. Her research focus was the role of genes, environment and evolution in eye development and malformations.

… and some Rising Stars of the Part II Class

Kate Arkless Gray (2000/01)
A freelance print and radio journalist, with web alter-egos SpaceKate and RadioKate. In 2022 Kate was named YunoJuno's Social Media Freelancer of the Year. She has 20 years multimedia experience, ranging from a role with a commercial space company to developing Al Jazeera's first audio strategy and podcast pilot. She is also a committed advocate for diversity and women in STEM and passionate about pursuing her dream of going into space.

Jenny Bangham (1998/9)
Jenny is a scientist who became an historian. She is currently based at the University of Edinburgh and is an associate of Clare Hall, Cambridge. In 2014 Jenny was awarded the Marc-Auguste Pictet Prize in the History of the Life Sciences for her PhD thesis 'Blood groups and the rise of human genetics in mid-twentieth-century Britain' and continues to specialise in the history of C20 science.

Pierre Far (2000/01)
After his Part II year, Pierre remained in the Department of Genetics to study for his PhD. He was one of the founders of Cambridge University Technology and Enterprise Club (CUTEC). His interest in improving access to knowledge on the web led him to work for True Knowledge and Google, and to set up OCW Search. In 2015 he launched Deliberate Digital Ltd, offering web access advice and training.

Max Fitz-James (2012/13)
Max won the Thoday Prize for best Pt II in 2013. He completed his PhD at the Wellcome Trust Centre for Cell Biology in Edinburgh and then undertook postdoctoral work on epigenetic inheritance in Montpellier. He is now establishing his own lab in Oxford. In his spare time Max is a *University Challenge* question setter.

Edward Green (2004/05)
After finishing his PhD on circadian rhythms, Ed remained as a postdoc in the Department of Genetics at Leicester University, before moving to the German Cancer Research Centre (DKFZ) in Heidelberg, where he is a group leader in the field of immunogenomics.

Lizzie Perdeaux (2003/04)
After gaining a First ['Much to my surprise!'] Lizzie worked as an officer for small medical charities specialising in rare genetic diseases. Having suddenly one day come to the realisation, 'I really really hate pipetting!', Lizzie recognised that her greatest talent lay in communicating science. She is a blogger as well as a writer in the more conventional fashion and gives inspiring talks. Since 2023 she has been Scientific Director for Patient Partnerships at Envision Pharma Group.

Katherine Schon (2003/04)
After her Part II year, Katherine completed her clinical training and then undertook a PhD in clinical neuroscience. She is now a speciality registrar in clinical genetics at CUH and her research focusses on rare neurogenetic disorders, including mitochondrial disorders, Ataxia-Telangiectasia and congenital insensitivity to pain.

Alice Turnbull (2007/08)
Alice was awarded the Thoday Prize for best Genetics Part II, then stayed on at Cambridge to study for a PhD in Oncology and Gene Therapy. After working as a Life Sciences Consultant at Navigant (advising healthcare organisations on complex legal issues), she managed the *Maintaining Cancer Genetics* programme at The Institute of Cancer Research and is now Director at Health Data Research (HDR) UK.

How to Apply

All students are required to register their Departmental preferences on-line through CamSIS.

This booklet, together with our website (https://www.gen.cam.ac.uk/undergraduate/genetics-for-pt1) should provide the necessary background information about the Department of Genetics and our Part II course.

Students considering taking Part II Genetics are invited to come along to the **Part II Subject Fair** on **Tuesday 28th April, 12 noon – 4pm** in the **PDN Experimental Lab**. Genetics staff and students (current and past Part IIs) will be there to chat and answer questions about the course.

Information on the course is also available in the Genetics folder on the **NST Part II Subjects Fair Moodle site**.

Preparation and previous courses of study

There are no compulsory prior courses or prerequisites for admission to Part II Genetics; we are looking above all for students with a genuine interest in genetics, who will get the most out of our stimulating course.

Part II Genetics students from the Natural Science Tripos will typically have taken courses such as Part IA Biology of Cells, IA Evolution & Behaviour, IA Mathematical Biology, Part IB Cell & Developmental Biology (or IB Biochemistry & Molecular Biology), IB Evolution & Animal Diversity, and IB Mathematical & Computational Biology.

Medical and veterinary students may also elect to take this course before proceeding to their clinical studies and often form a significant proportion of the class. Students with a background in the physical sciences or mathematics have also done well in Part II Genetics in the past, and we welcome applications from such students.

Please be aware that NST2GN and NST2BBS (Genetics) students opting to take the Mathematical Genetics module will need to have the required computational and mathematical skills. The expectation is that NST students selecting it will have taken IB MCB. However, any student wishing to select the Mathematical Genetics module, who has not taken MCB (including MedST and VetST students), will be considered on a case-by-case basis.

For all incoming Part IIs who have not taken IA Biology of Cells, IA E&B and/or IB CDB, access is granted to the previous year's version of the Moodle sites for these courses, so that they can consult lecture notes over the long vacation. The Department will also suggest material for directed reading prior to the course.

Vacation Research

Hands-on experience is an invaluable bonus when it comes to getting a foot in the door in research. The way that undergraduates, wanting to carry out summer vacation research in the UK, are funded has undergone extensive change in recent years. This has been to ensure that funding schemes meet the legal requirement that students receive the Real Living Wage. Information on possible sources of funding and on how to apply can be found on our website at: http://www.gen.cam.ac.uk/undergraduate/vacation-research

Interested students should approach Group Leaders directly to find out if they have research opportunities in their Labs: See our listing of labs. Obviously the earlier you apply, the better. Some closing dates for funding are as early as February/March.

Department of Genetics Summer Research Studentship
The Department of Genetics offers a small number of undergraduate short (up to 10-week) research bursaries. They are open to second year students, in either NST or MVST, who intend to read Part II Genetics as their final year option.

The research must be carried out under the supervision of a Principal Investigator who is a member of the Department of Genetics. A list of research groups and their fields of research can be found on our web site at See our listing of labs. Students will receive stipends at the living wage level.

Details on how to apply, and application forms are available from the Department of Genetics website: http://www.gen.cam.ac.uk/undergraduate/vacation-research
Applicants will be asked to provide a CV and a brief description of the proposed project, which must have been discussed with the head of the host laboratory. **The deadline for applications is 1st May** and successful applicants will be informed as soon as possible after this (no later than the end of May).

The Richard Wilson Research Bursary
The Department of Genetics is delighted to announce a Bursary to encourage research exchanges in genetics between The University of Cambridge and the University of Glasgow. Bursaries are funded by the generosity of the late Dr Richard Wilson, Glasgow Genetics Department, who spent 40 years conveying his enthusiasm for genetics and evolutionary biology to students and research colleagues alike.

The Richard Wilson Bursary supports funding of student exchanges between Glasgow and Cambridge and will facilitate undergraduate students at any stage from the University of Glasgow or Cambridge to study at the opposite University. Glasgow students coming to Cambridge for periods of 8-10 weeks will receive stipends at the living wage level.

University of Cambridge students wishing to spend a summer in a lab at the University of Glasgow carrying out research in the general area of genetics should contact hodsec@gen.cam.ac.uk for further details.

Completed applications for all summer awards should be returned to the Secretary to the Head of Department at: hodsec@gen.cam.ac.uk. **The deadline for applications is 1st May** and successful applicants will be informed as soon as possible (no later than the end of May).

General bursaries – open to all students

Experience Postgrad Life Sciences: Students will receive the Real Living Wage and will be accommodated at Corpus Christi.

Genetics Society Summer Studentship Grants:
The Genetics Society has grants available to support students to gain experience in any area of genetics by doing a research project during the summer holiday prior to the final year of their degree.

Amgen: Support for students participating in the Amgen Scholars Programme.

In addition, places where students have previously received studentships to come to the Department include:
BSDB (http://bsdb.org/awards/gurdon-studentships-for-summer-vacation-work/)
BSCB (https://bscb.org/competitions-awardsgrants/studentships/)
Balfour-Brown Fund (Cambridge Zoology, open to students who will take internships in other departments https://www.zoo.cam.ac.uk/intranet/professional-services/introduction/trust-funds/balfour-browne-fund)

Colleges: Many colleges provide funds to help support students wishing to broaden their experience by conducting research over the summer period.

Collated information about undergrad funding can be found at:
https://www.bio.cam.ac.uk/research-funding-opportunities-undergraduates

In this useful piece in Varsity, Bethan Clarke talks about the value of her experiences on an informal placement in the Steventon Lab during the summer between Part 1A and Part 1B.

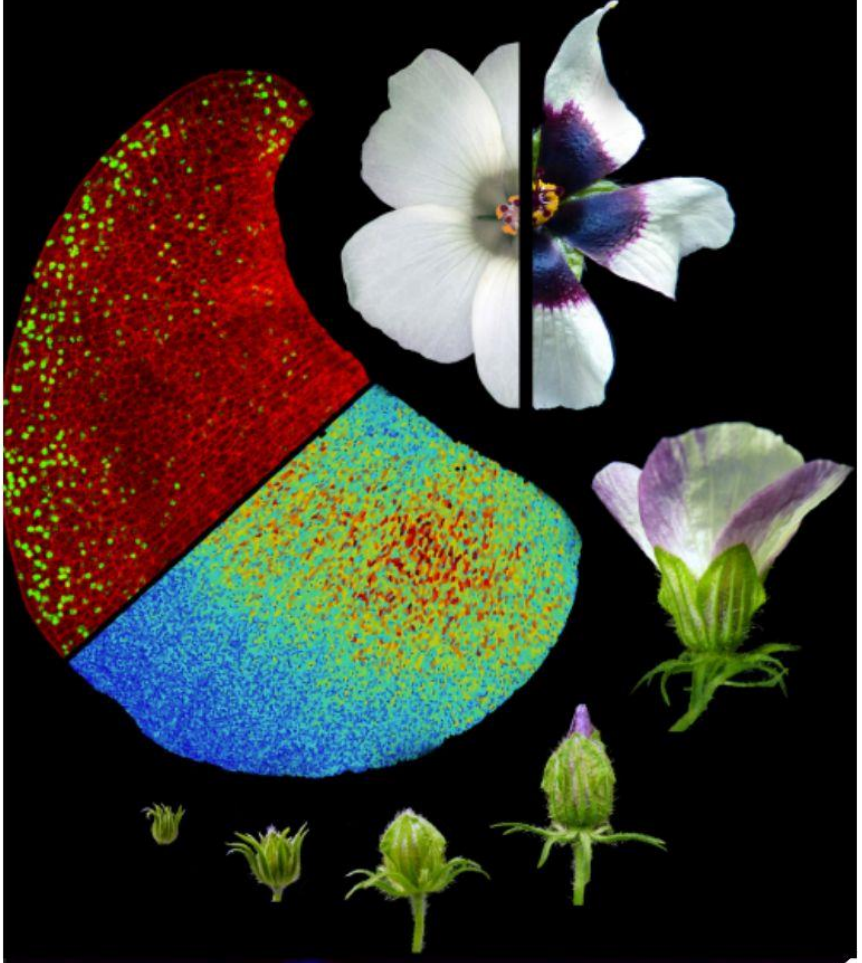
Interested students should approach staff members directly to find out if they have vacation research opportunities, funding and space available at See our listing of labs.

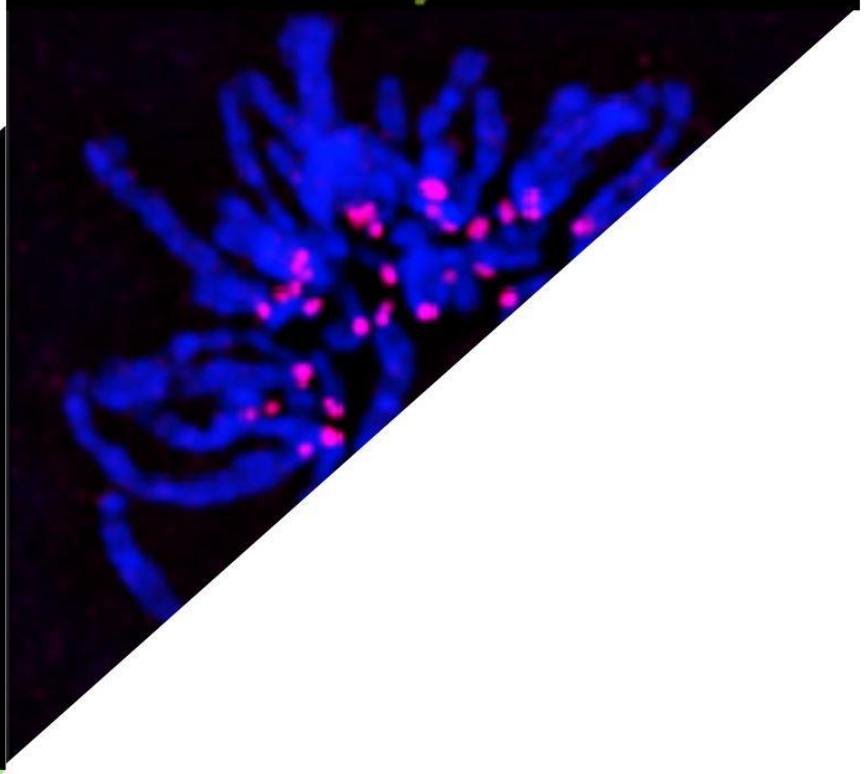
For further information on the Part II Genetics Course:

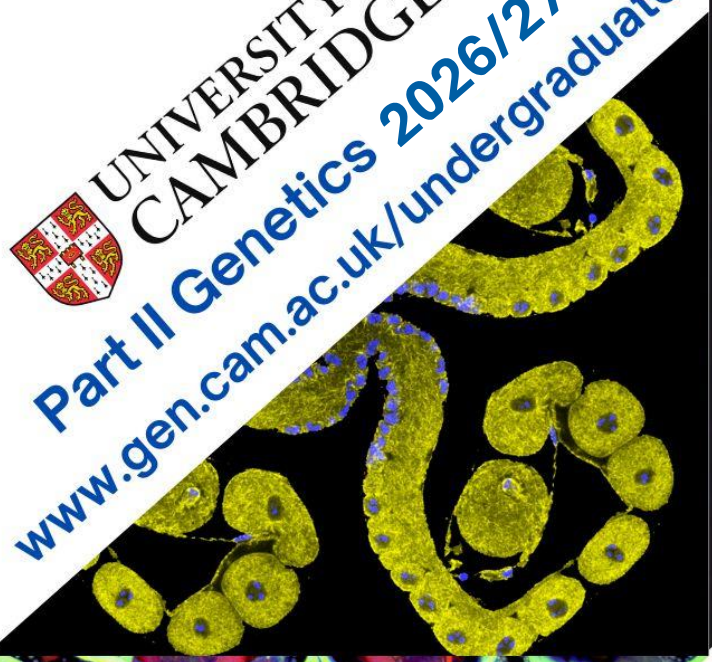
- Come along and chat to us at the Part II Subjects Fair on **Tuesday 28th April**
- Visit our website : https://www.gen.cam.ac.uk/undergraduate/genetics-for-pt1
- Visit our folder on the NST2 Subjects Fair Moodle site
- Scan the QR code below
- For general information about the course e-mail: ugadm@gen.cam.ac.uk
- To contact the course organisers: ptIIorganisers@gen.cam.ac.uk

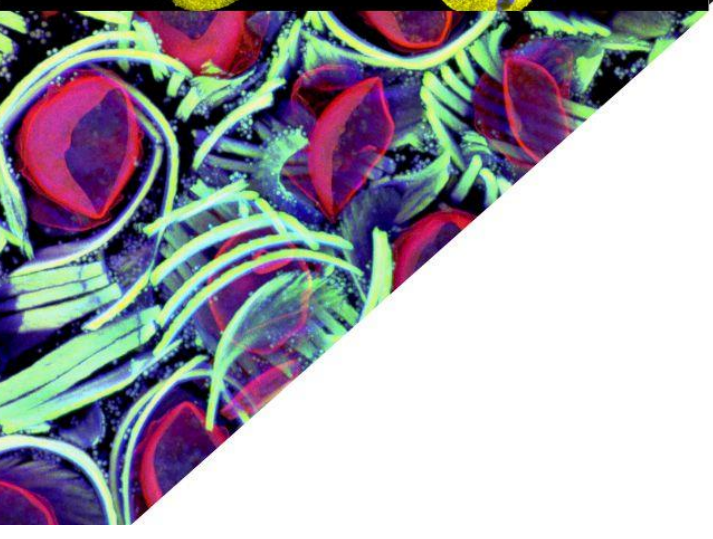
Several members of this Department teach IA and IB NST and MVST:
Prof Cahir O'Kane, Prof Aylwyn Scally, Prof Frank Jiggins, Dr Marco Geymonat, Prof Marisa Segal, Prof John Welch, Prof Steve Russell, Prof Ben Steventon, Prof Felipe Karam Teixeira, Prof Henrik Salje, Prof Richard Durbin, Prof Kate Baker and Dr Paul Fannon.

They can supply further information about the Department and the Part II course. Most can be contacted by email at the generic address: first initial.surname@gen.cam.ac.uk (no spaces or apostrophes).









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Part II Genetics 2026/27

www.gen.cam.ac.uk/undergraduate