Imperial College London

DEPARTMENT OF LIFE SCIENCES

Faculty of Natural Sciences

MSc Taxonomy and Biodiversity &

MRes Biosystematics

STUDENT GUIDEBOOK 2016–17

Contents

Welcome to the College

Congratulations on joining Imperial College London, the only university in the UK to focus exclusively on science, medicine, engineering and business.

From Fleming's discovery of Penicillin to Gabor's invention of holography, Imperial has been changing the world for well over 100 years. You're now part of this prestigious community of discovery and we hope you will take this opportunity to make your own unique contribution.

We're committed to providing you with the very best academic resources to enrich your experience. We also provide a dedicated support network and a range of specialist support services to make sure you have access to the appropriate help, whether that's further training in an academic skill like note taking or simply having someone to talk to.

You'll have access to an innovative range of professional development courses within our Graduate School throughout your time here, as well as opportunities to meet students from across the College at academic and social events – see page 6 for more information.

We actively encourage you to seek out help when you need it and try to maintain a healthy work-life balance. Our choice of over 340 clubs, societies and projects is one of the largest of any UK university, making it easy to do something different with your downtime. You also have free access to gym (following a one-off orientation fee of £40 in 2016) and swimming facilities across our campuses.

As one of the best universities in the world, we are committed to inspiring the next generation of scientists, engineers, clinicians and business leaders by continuing to share the wonder of what we do through public engagement events. Postgraduate students, alongside our academics and undergraduate students, make a significant contribution to events such as our annual Imperial Festival and our term-time Imperial Fringe events – if you're interested in getting involved then there will be opportunities for you to do so.

Welcome

Professor Sue Gibson,
Director of the Graduate School

The Graduate School has several roles but our main functions are to provide a broad, effective and innovative range of professional skills development courses and to facilitate interdisciplinary interactions by providing opportunities for students to meet at academic and social events. Whether you wish to pursue a career in academia, industry or something else, professional skills development training will improve your personal impact and will help you to become a productive and successful researcher.

Professional skills courses for Master's students are called "Masterclasses" and they cover a range of themes, for example, presentation skills, academic writing and leadership skills (see page 6 for more information).

All Masterclasses are free of charge to Imperial Master's students and I would encourage you to take as many as you can to supplement your academic training. The Graduate School works closely with the Graduate Students' Union (GSU) and is keen to respond to student needs, so if there is an area of skills training or an activity that you would like us to offer, but which is not currently provided, please do get in touch (see page 6).

The Graduate School also runs a number of exciting social events throughout the year which are an opportunity to broaden your knowledge as well as to meet other students and have fun. Particular highlights include the Ig Nobel Awards Tour Show, the Chemistry Show and the 3-minute thesis competition. You should regularly check the Graduate School's website and e-newsletters to keep up to date with all the events and training courses available to you.

Finally, I hope that you enjoy your studies here at Imperial, and I wish you well.

Welcome

Dr Janet De Wilde,
Head of Postgraduate Professional Development

I would like to welcome you to the Graduate School programme for postgraduate professional development. Our team of tutors come from a wide variety of experiences and we understand just how important it is to develop professional skills whilst undertaking postgraduate studies and research. Not only will this development improve your success during your time at Imperial, it will also prepare you for your future careers. We are continually working to develop the courses we offer and over this year you will see a range of new courses including face-to-face workshops, interactive webinars and online self-paced courses. I encourage you to explore and engage with the diverse range of opportunities on offer from the graduate school and I wish you well in your studies.

The Graduate School

You automatically become a member of the Graduate School when you register as a postgraduate student at Imperial.

The Graduate School has been set up to support all postgraduate students at the College through:

- Training and development courses
- Networking activities, social and academic events to encourage cross-disciplinary interactions
- Forums to represent the views of postgraduate students throughout the College

‘Masterclass’ professional skills courses

You can see the full range of free professional skills courses for postgraduate students on the Graduate School website:

www.imperial.ac.uk/study/pg/graduate-school/professional-skills/masters

All courses can be booked online.

Contact us

Level 3, Sherfield Building, South Kensington Campus

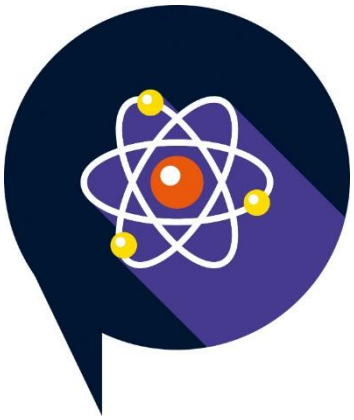
020 7594 1383

graduate.school@imperial.ac.uk

www.imperial.ac.uk/graduate-school

Imperial Success Guide

The Imperial Success Guide is an online resource with advice and tips on the transition to Master’s level study. More than just a study guide, it is packed with advice created especially for Imperial Master’s students, including information on support, health and well-being and ideas to help you make the most of London.



www.imperial.ac.uk/success-guide

Introduction from the President of the Graduate Students' Union

I am delighted to welcome you to Imperial, and to the Graduate Students' Union (GSU). I hope that your time here will be fulfilling and valuable, and the GSU is here to try and facilitate this.

Imperial College London is such a wonderful and transformative place that provides a unique and thrilling environment for research and for advanced studies, and the graduate students are a vital and valued part of the wider community of Imperial. Our graduate students are at the forefront of the research done. Therefore, at the GSU we ensure that the experience here fosters both academic achievement and personal development in our students.

The GSU is a University-wide representative body for postgraduate students at Imperial. It promotes the interests and welfare of its members, provides social and recreational activities and advocate for you and your opinions to the University and bodies external to the university. I encourage you to become an active member of the GSU– through involvement in your departments and the many University societies, and through our representational and campaigning activities.

I wish you all a fantastic time here at Imperial. Please take advantage of our rich community, and hope to meet you all soon.

Ahmed Shamso

gsu.president@imperial.ac.uk

1. Introduction to the Department

Academic and administrative staff

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English language requirement

If you are not a native English speaker you must meet the College's English language requirements.

See the Admissions website for details:

www.imperial.ac.uk/study/pg/apply/requirements/english

For information on English language support available while you're here, see page 28.

Attendance and absence

You must inform your Postgraduate Tutor if you are absent from the College for more than three days during term. If the absence is due to illness you must produce a medical certificate after seven days. If you miss an examination through illness you must produce a medical certificate immediately.

The Registry will be informed of all student non-attendances as the College is obliged to report the non-attendance of students on Tier 4 visas to the Home Office.

Teaching is loosely based on term dates but projects continue throughout the academic year and not just the undergraduate terms.

Key dates 2016–17

Term dates

Autumn term:	1 October–16 December 2016
Spring term:	7 January–24 March 2016
Summer term:	29 April–30 June 2016

Closure dates

Christmas/New year:	24 December 2016–3 January 2017
Easter holiday:	12 April –18 April Month 2017
Early May bank holiday:	1 May 2017
Spring bank holiday:	29 May 2017
Summer bank holiday:	28 August 2017

Key events

Postgraduate Awards Ceremonies:	3 May 2017 (provisional date)
Imperial Festival and Alumni Festival:	6–7 May 2017

2. Programme information

Welcome to the Natural History Museum and Imperial College London

The MSc *Taxonomy and Biodiversity* and MRes *Biosystematics* are run jointly by Imperial College London and the Natural History Museum (NHM). The MSc has been in existence for over 20 years, and the MRes was introduced in October 2002. Combined, these courses have trained nearly 500 students. Our graduates have gone on to successful careers in academia, research, museum curation, publishing, teaching, and many others fields.

The courses are taught by researchers from both institutions. At NHM, there are two large research departments in Life Sciences and Earth Sciences. Both will contribute to teaching of the courses, mainly in taxonomy, phylogenetics, biodiversity and palaeontology. At Imperial, lecturers come from the Ecology and Evolution section at Silwood Park. Lecturers will mainly contribute to teaching of quantitative skills for ecology, environmental science and genomics. Silwood is one of Imperial's campuses located near Ascot, Berkshire, in a large tract of woodland used for field studies. While much of the MSc is taught at the NHM, the statistics, genomics and GIS modules will be held at Silwood Park.

This handbook gives you information on various aspects of this course and about studying at Imperial and NHM. You will be part of two major research institutions that have highly complementary aims in research and teaching. This gives you the opportunity to learn from a truly diverse set of lecturers, all of them specialists in their field. Likewise, lecturers and researchers at both institutions are keen to work with the students on the Masters courses. We wish you an enjoyable year!

2.1 MSc Taxonomy and Biodiversity

Objectives

Taxonomy and systematics provide the foundation for studying the diversity of the living world. The course provides a broad perspective on these disciplines and how they are used for a better understanding of the magnitude, distribution and origin of species diversity on Earth. We are taking an evolutionary (historical) perspective to biodiversity. At the core of this approach are phylogenetic trees and 'tree thinking'. This is an exciting time for the field, as new digital and molecular technologies provide amazing opportunities for a new generation of scientists. Students on the course should become expert in these new tools, in addition to understanding the broader concepts of taxonomy and biodiversity. Most importantly, you should gain the abilities to work as an independent scientist and researcher, to be able to solve questions about the future of biodiversity and to communicate them to peers and the public.

You will be trained in practical and conceptual issues in taxonomy and biodiversity, starting from phylogenetic principles. The course provides methodological background, quantitative skills, practical skills in morphological and molecular techniques of taxonomy and systematics, and experience with computer applications. The most up-to-date ideas and research in taxonomy and biodiversity are taught, to a large extent from primary literature. Hands-on training in conducting research in this area is provided by project supervisors, with specialisation in the students' field of choice.

Aims of the course

The aims of the course are to enable students to:

- Apply a wide range of techniques to the study of systematics, including taxonomic revision, phylogeny reconstruction, key construction, identification, collections management, and comparative methodologies

- Understand the diversity of living organisms in space and time and be familiar with methods for measuring this diversity and monitoring changes due to both anthropogenic and natural factors

- Select appropriate methods to solve taxonomic and biodiversity problems, and be able to acquire and analyse taxonomic data, including both traditional and molecular data

- Understand fully the conceptual basis of taxonomy and phylogenetics, including phylogeny reconstruction using cladistics and model-based approaches, and to understand "biodiversity" within this framework

- Apply these concepts to issues of biodiversity and conservation management and research, to set priorities for sustainable development, environmental assessment and inventories; apply these concepts to other areas of biology such as parasitology and epidemiology

Course Organisation

The courses run for one year from the 3 October 2016 through to the end of September 2017. The taught components of the courses (lectures and practicals/workshops) typically start at 10:00 and finish by 16:30 but this varies from week to week – details for each week are provided in the timetable appended to this handbook. Please note that the exact timetable is subject to changes but these will communicated well in advance of the start of each module. Wednesday morning is either used for taught material or reserved for private study and Wednesday afternoon is normally reserved for sports, leisure activities or private study. It is anticipated that reading and coursework will require additional study in your own time. During research projects, you are expected to work full time on the project, including Wednesday afternoons. Some projects may require out-of-hours work, for example maintaining greenhouse experiments.

The MSc course is comprised of ten compulsory modules, in addition to a 4-months research project. Each module includes lectures, practicals, seminars, tutorials, and computing and library research projects, as appropriate. For the research projects, students are given the opportunity to specialise in their chosen field, and the research project can cover any subject relating to systematics, including library based research, molecular methods, or morphological techniques.

Time table and Module descriptions

MSc Taxonomy and Biodiversity and MRes Biosystematics 2016/17

Timetable – Year at a glance

Week	Date	Module	Module Title	Module Leader	Location	MSc	MRes	Assessment
1	03/10/2016	1	Induction	Alfried Vogler	NHM			
2	10/10/2016	2	Field course @ NHM	Alfried Vogler	NHM			MSc Assignment 1 set
3	17/10/2016	3	Biological computing in R	Samraat Pawar	Silwood			
4	24/10/2016	4	Introduction to Statistics and R	Julia Schroeder	Silwood			
5	31/10/2016	5	GIS	Rob Ewers	Silwood			
6	07/11/2016	6	Genomics and bioinformatics	Jason Hodgson	Silwood			
7	14/11/2016	7	Ecology and global change	Guy Woodward	Silwood		Project 1	
8	21/11/2016	8	Phylogenetic reconstruction	Ian Kitching	NHM			
9	28/11/2016	9	Molecular systematics 1	Alfried Vogler	NHM			MSc Assignment 2 set
10	05/12/2016	9	Molecular systematics 2	Alfried Vogler	NHM			MSc Assignment 1 deadline
11	12/12/2016		Reading		NHM			

	19/12/2016		Reading		NHM			MSc Assignment 2 deadline
1	09/01/2017		Exams		ICL			Provisional 13 January 2017 SAF460
2	16/01/2017	10	Generalised linear models	Julia Schroeder	Silwood			
3	23/01/2017	10	Advanced statistics	Julia Schroeder	Silwood			
4	30/01/2017 - 07/02/2017	33	Palaeobiology	Richard Twitchett	NHM			MSc Assignment 3
5	08/02/2017	34	Genetic mechanisms of evolution	Arkhat Abzhanov	NHM			
7	13/02/2017	41	Natural history collections	Martha Richter	NHM			MRes Project 1 Oral Presentation MSc Assignment 3
6	20-22/02/2017	24	Principles of taxonomy	Alfried Vogler	NHM		Project 2	
8	23-24/02/2017 and 27/02/2017	43	Methods in macroecology and macroevolution	Natalie Cooper	NHM			MSc Assignment 4 set
9	06/03/2017	44	Species and speciation	Alfried Vogler	NHM			
10	13/03/2017		Reading		ICL			MSc Assignment 4 deadline
11	20/03/2017				ICL			
12	27/03/2017		Exams		NHM			
1	29/04/2017		Projects	Various supervisors				
2	01/05/2017							
3	08/05/2017							
4	15/05/2017							
5	22/05/207							
6	29/05/2017							
7	05/06/2017							MRes Project 2 and Oral Pres
8	12/06/2017						Project 3	
9	19/06/2017							
10	26/06/2017							
11	03/07/2017							
12	10/07/2017							

13	17/07/2017							
14	24/07/2017							
15	31/07/2017							
16	07/08/2017							
17	14/08/2017							
18	21/08/2017							
19	28/08/2017							
20	04/09/2017							MSc Project and Oral Presentation
21	11/09/2017							MRes Project 3 an Oral Pres

Module 1: Field Course and Tree of Life

Description

The module takes a pass through the various groups of the living world, as we aim to familiarise ourselves with the objects we will be studying in this course. We introduce the major lineages that separated deep in time, including the major Domains of life and large groups of metazoan animals, while also looking at very recent splits, such the diversification of lineages leading to our own species. The study of living organisms also requires that we know how to find them in the field and how to prepare them for long-term storage in museum collections for further studies. The module therefore will introduce a range of field survey and assessment skills, along with basic taxonomy and identification keys for a range of groups

Aims

- Become familiar with the major components of the Tree-of-Life
- Learn to appreciate 'tree thinking' for the study of biological diversity
- Obtain hands-on experience with field collection methods for animals and plants
- Use of identification keys and develop basic taxonomic knowledge of organisms
- Learn the basic statistic analyses for the study of biodiversity samples

Reading List

- Southwood and Henderson. (2000) Ecological Methods. 3rd Edition. Blackwell.
- David A. Baum and Stacey D. Smith (2013). Tree Thinking: An Introduction to Phylogenetic Biology

Module 2: Biological computing in R

Description

In this module, you will learn how to use this freely available statistical software with strong programming capabilities. {\tt R} has become tremendously popular in Biology due to several factors: (i) many packages are available to perform all sorts of statistical and mathematical analysis, (ii) it can produce beautiful graphics, and (iii) it has a very good support for matrix-algebra (you might not know it, but you use it!). So with {\tt R}, you have an expanded and versatile suite of biological computing tools at your fingertips, especially for automating statistical analysis and the generation of figures. Therefore, {\tt R} should become an indispensable component of your biological research workflow.

Aims

- Learn how to use {\tt R} for data exploration
- Learn how to use {\tt R} for data visualization and producing elegant, intuitive, and publication quality graphics.
- Learn {\tt R} data types \& structures and control flows.
- Learn how to write and debug efficient {\tt R} scripts and functions.
- Learn how to use {\tt R} packages.

Reading List

- The Use R! series (the yellow books) by Springer are really good. In particular, consider: `A Beginner's Guide to R', `R by Example', `Numerical Ecology With R', `ggplot2' (we'll see this in another week), `A Primer of Ecology with R', `Nonlinear Regression with R', `Analysis of Phylogenetics and Evolution with R'.
- Ben Bolker's `Ecological Models and Data in R'
- For more focus on dynamical models: Soetaert \& Herman. 2009 `A practical guide to ecological modelling: using R as a simulation platform'.
- There are excellent websites. Besides \href{http://cran.r-project.org}{CRAN} (containing all sorts of guides and manuals), you should check out \href{http://www.statmethods.net}{www.statmethods.net} and \href{http://http://en.wikibooks.org/wiki/R_Programming}{en.wikibooks.org/wiki/R_Programming} and google `R Graph Gallery' for various sites showing graphing options and code.

Module 3: Statistics in R

Description

In this module we will build upon the introduction to R you received in "Biological computing in R" and review a core set of statistical methods that are of wide use in research projects. These statistical tests will form the basis for many data analyses you will do in the future. This module is shared with most courses and runs in two blocks A and B like the previous module.

Aims

- The difference between response and explanatory variables and between ordinal, categorical and continuous variables
- The underlying structure of statistical testing using both parametric and non-parametric approaches
- Tests for assessing differences between samples and correlation between samples
- Analysis of categorical data
- Fitting and assessing linear models of continuous response variables.

Reading List

There are a wide range of introductory books for R. See later statistics and computing modules for more specialist texts but, for this week, the following are good introductory and reference texts that are available in Silwood library and as an e-book through Imperial:

Main reference: - Crawley, Michael J (2012) Statistics: An Introduction Using R. John Wiley. http://imperial.eblib.com/patron/FullRecord.aspx?p=827080.

A gentler introduction: - Beckerman, Andrew P. and Petchey, Owen (2012)

Getting Started with R : An introduction for biologists Oxford University Press.

http://imperial.eblib.com/patron/FullRecord.aspx?p=886478.

Module 4: Geographic Information Systems (GIS)

Description

This week will teach key skills in using and handling GIS data, along with basic remote sensing to generate GIS data and the use of GIS data in a range of applications. We will use the open

source GIS program QGIS (http://www.qgis.org/). We will look at creating and georeferencing both vector and raster data and how to use GIS tools to create a workflow to carry out simple analyses.

Aims

At the end of this module you should have:

- Familiarity with a range of GIS data types
- Confidence in obtaining and handling GIS data
- Familiarity with open source tools for GIS
- Practical experience in applying GIS to ecological and evolutionary questions

Reading List

- GIS overview: Longley, PA (2011) Geographical information systems and science. Wiley.
- Land use change modelling: Rosa et al. (2013) Predictive modelling of contagious deforestation in the Brazilian Amazon. PLoS ONE 8:e77231.
- Coordinate systems: Van Sickle, G (2010) Basic GIS coordinates. CRC Press \url{https://www.dawsonera.com/abstract/9781420092325

Module 5: Genomics and Bioinformatics

Description

Genetic data contain information about who organisms are, their relationships to other organisms, their population histories, and their histories of adaptation. Thus, genetic data and genetic techniques are central to addressing many questions in evolution, ecology, and conservation. New technologies allow for genetic characterization at the genomic level, and these data allow for an understanding of population processes at resolutions not possible in the past. The goal of this module is to introduce students to the types of questions that can be addressed with genomic data, and the methodologies that are available for answering these questions. Learning will be accomplished through a mix of lectures, computer practicals and group discussions.

Aims

- An understanding of genomic data collection methods, and how to choose the data collection technique most appropriate to your question.
- An understanding of the wealth of data available to biologists in public genomic databases.
- An understanding of how genetic structure develops within and between populations, how to characterise it, and how to interpret the results of common analyses such as STRUCTURE and PCA.
- An understanding of how demographic history affects genomic variation, and how to infer past population expansions and contractions from genomic data.
- An understanding of how migration affects genomic variation, and how patterns of gene flow can be inferred from genomic data.
- An understanding of how natural selection affects genomic variation, and how selection can be identified from genomic data.
- An understanding of how phylogenetic relationships among species can be inferred, and what this information can tell us about evolution and conservation efforts.

Reading List

1. Novembre, J. & Ramachandran, S. Perspectives on human population structure at the cusp of the sequencing era. Annual review of genomics and human genetics 12, 245-274, doi:10.1146/annurev-genom-090810-183123 (2011).
2. Pritchard, J. K., Stephens, M. & Donnelly, P. Inference of population structure using multilocus genotype data. Genetics 155, 945-959 (2000).
3. Bertorelle, G., Benazzo, A. & Mona, S. ABC as a flexible framework to estimate demography over space and time: some cons, many pros. Molecular ecology 19, 2609-2625, doi:10.1111/j.1365-294X.2010.04690.x (2010).
4. Li, H. & Durbin, R. Inference of human population history from individual whole-genome sequences. Nature 475, 493-496, doi:10.1038/nature10231 (2011).
5. Pozzi, L. et al. Primate phylogenetic relationships and divergence dates inferred from complete mitochondrial genomes. Molecular phylogenetics and evolution, doi:10.1016/j.ympev.2014.02.023 (2014).
6. Purvis, A., Agapow, P. M., Gittleman, J. L. & Mace, G. M. Nonrandom extinction and the loss of evolutionary history. Science 288, 328-330 (2000).
7. Jarvis, E. D. et al. Whole-genome analyses resolve early branches in the tree of life of modern birds. Science 346, 1320-1331, doi:10.1126/science.1253451 (2014).
8. Zhang, G. et al. Comparative genomics reveals insights into avian genome evolution and adaptation. Science 346, 1311-1320, doi:10.1126/science.1251385 (2014).
9. Barreiro, L. B., Laval, G., Quach, H., Patin, E. & Quintana-Murci, L. Natural selection has driven population differentiation in modern humans. Nat Genet 40, 340-345 (2008).
10. Sabeti, P. C. et al. Genome-wide detection and characterization of positive selection in human populations. Nature 449, 913-918 (2007).
11. Ouborg, N. J., Pertoldi, C., Loeschcke, V., Bijlsma, R. K. & Hedrick, P. W. Conservation genetics in transition to conservation genomics. Trends Genet 26, 177-187, doi:10.1016/j.tig.2010.01.001 (2010).
12. Lopes, C. M. et al. DNA metabarcoding diet analysis for species with parapatric vs sympatric distribution: a case study on subterranean rodents. Heredity (Edinb) 114, 525-536, doi:10.1038/hdy.2014.109 (2015).

Module 6: Phylogenetic Reconstruction

Description

This module considers the theory and practice of phylogenetic reconstruction under the principle of parsimony, and with particular reference to the analysis of morphological data. The principles of cladistics are introduced and the methods used to construct and assess cladograms explained.

Aims

Upon completion of this module, students should be able to:

- Understand the theory of cladistic analysis for phylogenetic reconstruction;
- Collect data suitable for a cladistic analysis;
- Code data appropriately;
- Analyse data fully using a range of methods;
- Assess the support accorded to a cladogram and its included groups;
- Convert the resulting preferred hypothesis of relationships into a formal classification.

Coursework: Written report on the phylogenetics practical.

Reading List

1. Kitching, I.J., Forey, P.L., Humphries, C.J. and Williams, D.M. (Eds), 1998. *Cladistics* (Second edition). *The theory and practice of parsimony analysis*. Systematics Association Publication 11. Oxford University Press, Oxford.
2. Schuh, R.T. & Brower, A.V.Z. 2009. *Biological systematics: principles and applications* (second edition). Comstock Publishing Associates, Cornell University Press.

General background reading

Ax, P. 1987. *The phylogenetic system*. John Wiley & Sons, Colchester.

Eldredge, N. & Cracraft, J. 1980. *Phylogenetic patterns and the evolutionary process*. Columbia University Press, New York.

Gould, S.J. 1977. *Ontogeny and phylogeny*. Belknap Press of Harvard University Press, Cambridge, Massachusetts.

Hennig, W. 1966. *Phylogenetic systematics.* University of Illinois Press, Urbana.

Humphries, C.J. (Ed.) 1988. *Ontogeny and Systematics*. British Museum (Natural History), London.

Nelson, G.J. & Platnick, N.I. 1981. *Systematics and biogeography: cladistics and vicariance*. Columbia University Press, New York.

Rieppel, O. 1988. *Fundamentals of comparative biology*. Birkhauser Verlag.

Platnick, N.I. & Funk, V.A. 1983. *Advances in cladistics, volume 2*. Proceedings of the Second Meeting of the Willi Hennig Society. Columbia University Press, New York.

Schuh, R.T. 2000. *Biological systematics: principles and applications*. Princeton University Press.

Scotland, R.W. & Pennington, R.T. 2000. *Homology and systematics. Coding characters for phylogenetic analysis*. Systematics Association Special Volume 58. Taylor & Francis, London.

Scotland, R.W., Siebert, D.J. & Williams, D.M. (Eds) 1994. *Models in phylogeny reconstruction.* Systematics Association Special Publication No. 52. Oxford University Press, Oxford.

Wiley, E.O. 1981. *Phylogenetics: the theory and practice of phylogenetic systematics.* Wiley Interscience, New York.

Wiley, E.O., Siegel-Causey, D., Brooks, D.R. & Funk, V.A. 1991. *The compleat cladist. A primer of phylogenetic systematics*. University of Kansas Special Publication No. 19.

Module 7: Molecular Systematics

Description

This module will lead through the recent methods of generating and analysing DNA data for phylogenetic reconstruction. This includes hands-on experience of DNA extraction and sequencing; editing and compilation of sequence data; next-generation sequencing (Illumina); bioinformatics; and the range of current methods for tree building. Molecular data require the use of model-based tree construction and we will build on the cladistic principles treated in the Phylogenetics Module to understand these. Associated lectures will give background about the patterns of variation in molecular data and how these affect the phylogenetic conclusions.

Aims

Obtain an understanding of model-based methods in molecular systematics

Learn bioinformatics procedure for the analysis of next-generation sequence data

Gain wet-lab experience in molecular systematics

Assessed Coursework: *Report (metabarcoding project)*

Reading List

- Paradis, E. 2012. Analysis of Phylogenetics and Evolution with R (Use R!) 2nd ed. Springer.
- Hillis, D. M, Moritz, C. and Mable, B. K. (Eds). 1996. *Molecular Systematics*. 2nd edition. Sinauer
- Yang, Z. (2014). Molecular evolution: A statistical approach
- Wiley, E.O. and Lieberman, B. S. (2011) Phylogenetics: Theory and Practice of Phylogenetic Systematics 2nd Edition. Wiley and Black
- Felsenstein, J., 2004. *Inferring phylogenies*. Sinauer, Sunderland MA.
- Shokralla, S., et al., *Massively parallel multiplex DNA sequencing for specimen identification using an Illumina MiSeq platform.* Scientific Reports, 2015. **5**.

Module 9: Generalised Linear Models

Description

This module builds on the basic linear models introduced in the previous term to introduce some key concepts that allow linear models to be applied to a wider range of research problems. This will include using generalised linear models to handle count and binomial data - where residuals are not expected to follow a normal distribution - and the use of structured models to allow for nonindependence in data and to control for known sources of variation in data.

Aims

- understand, apply and interpret GLMs and GLMMs

Reading List

Module 10: Palaeobiology

Description

This module aims to explore the special role palaeontological data has to play in studies of phylogeny, speciation, extinction and the responses of the biosphere to past climate change

Aims

From this course the student will gain an appreciation of the nature of the fossil record and the types of question that are currently being addressed using palaeontological data. He/she will also learn about some of the problems that may be encountered when using fossil data in phylogeny reconstruction or the mapping of speciation and biodiversity patterns over geological time.

Assessed Coursework: Multiple choice questions

Reading List

- Cobbett, A., Wilkinson, M. & Wills, M.A. 2007. Fossils impact as hard as living taxa in parsimony analysis of morphology. *Systematic Biology* **56** 253-266.
- Cowen, R. 2005. *History of Life*. Fourth Edition. Blackwell, Oxford, 324 pp.
- Foote, M. & Miller, A. I. 2007. *Principles of Paleontology* (third edition). W. H. Freeman & Co., New York.
- Hermsen, E. J. & Hendricks, J. R. 2008. W(h)ither fossils? Studying morphological character evolution in the age of molecular sequences. *Ann. Missouri Bot. Gard*. **95**: 72-100.
- Hofreiter, M. & Stewart, J. 2009. Ecological Change, Range Fluctuations and Population Dynamics during the Pleistocene. *Current Biology***19**, R584-R594; DOI 10.1016/j.cub.2009.06.030
- Kearney, M. & Clark, J.M. 2003. Problems due to missing data in phylogenetic analyses including fossils: a critical review. *Journal of Vertebrate Paleontology***23**: 263-274.
- Lister, A.M. & Stuart, A.J. 2008. The impact of climate change on large mammal distribution and extinction: evidence from the last glacial/interglacial transition. *ComptesRendusGéosciences***340**: 615-620.
- McGowan, A. J. & Smith, A. B. (eds) *Comparing the rock and fossil records: Implications for biodiversity studies*. Geological Society Special Publication **358**
- Mosbrugger, V., Utescher, T. &Dilcher, D. L. 2005 Cenozoic continental climatic evolution of Central Europe. *Proc. Natl. Acad. Sci. USA***102**(42), 14964–14969 (doi: 10.1073/pnas.0505267102).
- Parenti, L.R. and Ebach, M.C. 2009. Comparative Biogeography. University of California Press, 295 pp. Smith, A. B. 2007 Marine diversity through the Phanerozoic: problems and prospects. *Journal of the Geological Society* **164**: 731-746.

Module 11: Natural History Collections

Description

This module takes students through the issues involved in building and maintaining large natural history collection, and how the information contained in the collections can be made available through digitisation. The module includes a two-day 'collection experience' where each student is assigned to a collection manager to conduct curation work the NHM collection.

Aims

This module takes students through the stages of applied biodiversity work, as it relates to taxonomy and collection based research, and it demonstrates the new exciting opportunities arising from digital information associated with the collections, focusing on the following topics:.

- Museum collections and their management: aspects of long-term preservation of specimens in museums, the management of large and diverse scientific collections; and the risks to the different kinds of specimens. Theory and curatorial experience.
- Biodiversity informatics: The methodology for obtaining specimen data from collections, including imaging of specimens; their mobilisation on the internet and the current resources available to the scientific community; how to access the data and what they can be used for in the study of biodiversity.

Reading List

Drew, J. 2011. The role of natural history institutions and bioinformatics in conservation biology. Conservation Biology, DOI: 10.1111/j.1523-1739.2011.01725.x

Gosden, C & Knowles, C. 2001. Collecting colonialism: material culture and colonial change. Berg Publishers, 234 pp.

Graham, C.H. et al. 2004. New developments in museum-based informatics and application in biodiversity analysis. Trends in Ecology & Evolution. DOI: http://dx.doi.org/10.1016/j.tree.2004.07.006

Stern, W,T. 1981. The Natural History Museum at South Kensington: A History of the British Museum (Natural History) 1753-1980. Heinemann in association with the BM(NH), xxiii, 414p.

Suarez, A. & Tsutsui, N.D, 2004. The Value of Museum Collections for research and Society. BioScience, 54(1):66-74.

Thompson, J.M.A. 2015. Manual of Curatorship: A Guide to Museum Practice. 775 pp.

UNESCO, 1970. Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property – 1970- www.unesco.org/new/en/culture/themes/illicit-trafficking-of-cultural-property/1970-convention/

Module 12: Principles of Taxonomy

Description

The module will illustrate general principles of the theory and practice of taxonomy: the need for classifications and phylogenies; the history of taxonomy and classification; the principles of taxonomy and the various Codes; species descriptions and keys.

Aims

To become familiar with the questions and daily practice of taxonomy

Module 13: Methods in Macroecology and Macroevolution

Description

This module aims to introduce students to topics in macroecology and macroevolution, with particular emphasis on how we use large datasets and computational methods to study them.

Aims

Students will learn about the main patterns and processes studied in macroecology and macroevolution, as well as understanding how to apply state-of-the-art methods for testing questions in these fields using “big data”. They will also gain an appreciation of the limitations of these methods.

Assessed Coursework: *Multiple choice test and write-up of practical.*

Reading List

Macroecology

- Brown, James H. *Macroecology*. University of Chicago Press, 1995.
- Gaston, Kevin, and Tim Blackburn. *Pattern and process in macroecology*. John Wiley & Sons, 2008.
- Smith, Felisa A., John L. Gittleman, and James H. Brown, eds. *Foundations of macroecology: classic papers with commentaries*. University of Chicago Press, 2014.
- Keith et al. 2012 What is macroecology? http://rstb.royalsocietypublishing.org/content/371/1691/20150224.abstract
- Newbold et al. 2016. Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment. Science. http://science.sciencemag.org/content/353/6296/288.short
- Newbold et al 2015. Global effects of land use on local terrestrial biodiversity. Nature. http://www.nature.com/nature/journal/v520/n7545/abs/nature14324.html
- Tuomisto 2010. A consistent terminology for quantifying species diversity? Yes, it does exist. Oecologica. http://link.springer.com/article/10.1007/s00442-010-1812-0

The comparative method

- Kamilar & Cooper 2013. Phylogenetic signal in primate behaviour, ecology and life history. Phil Trans. http://rstb.royalsocietypublishing.org/content/368/1618/20120341.short
- Harvey PH, Pagel MD 1991 *The comparative method in evolutionary biology*, pp. 248. Oxford, UK: Oxford University Press.

Macroevolution

- Erwin 2000. Macroevolution is more than repeated rounds of microevolution. Evol & Devel. http://onlinelibrary.wiley.com/doi/10.1046/j.1525-142x.2000.00045.x/full
- Fenton et al 216. The impact of Cenozoic cooling on assemblage diversity in planktonic foraminifera. Phil Trans http://rstb.royalsocietypublishing.org/content/371/1691/20150224.abstract
- Rabosky 2014. Automatic Detection of Key Innovations, Rate Shifts, and Diversity-Dependence on Phylogenetic Trees. PLoS ONE. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0089543
- Schluter, Dolph. *The ecology of adaptive radiation*. OUP Oxford, 2000

Critical thinking about methods

- Cooper et al 2016 Shedding light on the 'dark side' of phylogenetic comparative methods. MEE. http://onlinelibrary.wiley.com/doi/10.1111/2041-210X.12533/full

Pennell et al 2015. Model Adequacy and the Macroevolution of Angiosperm Functional Traits. Am Nat. http://www.jstor.org/stable/10.1086/

Module 14: Species and Speciation

Description

This module addresses the 'species problem' in biology and how we recognise and identify species, including the use of molecular markers ('DNA barcoding'). We will also discuss the variation within species and the population-level processes that determine the fate of particular gene copies and permit conclusions about the recent history of populations.

Species is a term widely used through much of biology. But what do we mean by species? Is the term universally understood to refer to the same sorts of entities? Perhaps the greatest fundamental difference amongst contemporary systematists in this regard is between those who consider species as a real and 'special' unit of taxonomy or evolution and those who regard species as a taxon like any other, a clade at the tip of a tree with only the importance we choose to give it.

Aims:

- Learn about various species concepts and their limitations
- Understanding of the theory of species evolution and the link with population genetics:
- Appreciate the power and limitation of modern sequencing technology in DNA-based taxonomy and phylogeography
- Understand the various biological processes that drive speciation

Reading List

Scott V. Edwards, Sally Potter, C. Jonathan Schmitt, Jason G. Bragg, and Craig Moritz
Reticulation, divergence, and the phylogeography–phylogenetics continuum
PNAS 2016 113 (29) 8025-8032;

Hebert, P.D.N., et al., *Biological identifications through DNA barcodes.* Proceedings of the Royal Society B, 2003. 270: p. 313-321.

Coyne, J. A. and Orr, H. A. 2004. Speciation. Sinauer

Projects

A large part of the MSc comprises an individual Student Research Project. Some students may have particular projects in mind by the time they arrive, whilst others will develop ideas during the course of the taught part of the course. We maintain an online spreadsheet of available projects and new project proposals will be added to this throughout the year. The details of available projects are available from these two links:

Webpage http://goo.gl/GWtgy6

Tab delimited text file http://goo.gl/awH7Vf

This list is by no means exhaustive but if any student wants to find out more about any of these projects, they are encouraged to discuss the projects with the supervisors named.

You can choose to undertake projects based either at the Natural History Museum or at Imperial College (usually the Silwood Park campus). You may wish to choose a project for which a description has already been submitted by the supervisor, or you may wish to develop your own project in conjunction with an appropriate member of staff, either at the NHM or at Imperial. Topics have to be related to the general subject area of systematics and/or biodiversity, and should show the scope for original observation or experimental design. You should bear in mind that if you wish to undertake field work as part of your project, many organisations which offer funding to cover this may have early deadlines, e.g. the British Ecological Society (31st December) and the Systematic Association (1st January), and therefore any field-work associated projects should be planned early on in the course. Please discuss any ideas with Alfried Vogler before making any firm commitments. If the project is going to be undertaken at another institution, the course organisers must be informed in good time and an internal supervisor must also be nominated.

Supervisors

Each student on the course will have different backgrounds, different strengths and different interests and it is important that you find a supervisor whose interests match your own. Spend time on the NHM and Silwood Park websites reading about the research of Academic Staff, including Fellows and Postdocs. You can look up potential supervisors at the academic staff websites for NHM (http://www.nhm.ac.uk/our-science/departments-and-staff.html) and Silwood http://www.imperial.ac.uk/visit/campuses/silwood-park/academic-staff/

Make sure you prepare before making first contact with a supervisor and look up any projects they may have proposed on the above list. Generally the academic staff is keen to supervise these projects, so do not hesitate to establish contact, but before meeting or calling a potential supervisor, check through their past work and be ready to tell them what papers they've authored that you're particularly interested in, or what ideas you have for a project.

The Project proposal

Before selecting a project, it is required to submit a project proposal in pdf format after they have selected a project. A form will be provided that asks for a project description and signatures of the supervisor(s) and collection manager (where appropriate) who commit to supervision and access to relevant collections. The proposal will presumably be prepared under guidance of the project supervisor(s). The deadlines for submission will be given nearer the time and a pro forma is available through Blackboard.

The project description should give the title, an introduction to the project idea and proposed questions, methods, and a timeline of tasks (Gannt chart). These project descriptions must be approved by the Supervisor and Course Director prior to commencing the project.

Project Supervision Guidance

Each Masters project is an independent piece of research and we expect you to drive forward your project. Projects differ very widely, but the timelines suggested below are intended to give students and supervisors a rough framework. If you need training in a particular technique or advice on a particular problem, it is important to ask for help - that is what the supervisor is there for. However, do not expect to be told what to do or what to test - you need to *take ownership of the research* and have a strong command of the methods, literature and broad context of your work.

Your supervisor will be fundamentally interested in your research, but they will be busy. You should be well prepared for any meeting: have a list of clear questions and read the literature around those questions so you can suggest, for example, potential experts to consult with or methods to apply. Ask your supervisor how s/he prefers to communicate. Some supervisors will prefer meetings, whilst others will prefer email or telephone. If preferred by your supervisor, do not be afraid to email questions - you will often get a reply more quickly to a carefully phrased email than if you wait for a meeting.

Take the initiative and let your supervisors (and course directors) know how things are going. The time for completion of the project is very short. If supervisors become aware of problems too late it is more difficult to devise major changes. We're here to support you and every project has tough periods - do not be embarrassed to ask for help and support.

Guidelines for progress on your project

a. <u>First month</u>

You will almost certainly be straight into **data collection, theory development, or coding** through whether that is lab work/field work/computer work. You should however also be **reading the**

literature around your project voraciously. By the end of this first month, you should have a **draft of your introduction**: this must explain why your work is new and important, how it fits into the literature and why you are testing the hypotheses that you set out. Setting this out clearly now - whilst you still have time to adapt - is a huge step towards a successful project. It is also gets you to **write your project as you go along**. You might want to read this book:

> Paul J. Silva (2007) *How to Write a Lot: A Practical Guide to Productive Academic Writing Paperback.* American Psychological Association

The first few weeks are going to need the most input from the supervisors as students are uncertain about the process. You should agree a framework and a timetable for project progress with your supervisor and perhaps revisit and revise the Gantt chart that was submitted with the project proposal.

Set a deadline for a draft introduction and provide short feedback on literature coverage, hypothesis framing and writing style. Alternatively this could be a longer essay to provide a broader overview from which to condense an introduction.

b. <u>End of the first third</u>

You should now have made quite a bit of progress. It is very possible that initial attempts and methods have gone slightly wrong and you are only now beginning to see your data start roll in. Teething problems are a common part of research! However, you do now know what your methods are and what you are doing from day to day. **Write your project methods now whilst it is fresh in your mind.** Explain to yourself and your supervisor what you are doing so that anyone can replicate it - do not leave this until the end. As your work progresses, **update your methods** document but keep the paper style - you are not typing out your lab book, you are writing a paper. Share a draft of the methods with your supervisor at this period. It may not be complete but the supervisor can give guidance on the level of detail and whether the writing is compact enough.

c. <u>End of second third</u>

Your methods should now be pretty stabilised, so **reread your introduction and methods** and give them a bit of a polish. You almost certainly have enough data now to start preliminary analyses for some of your hypotheses. The dataset may be so small that the analyses have no power but you can **start to plot your figures** and **start to write the code to do your statistics.** Using this, start to **plan your results section**: write out the structure of your results and think about the key figures and tables? At this point, have a planning meeting with your supervisor to check that the hypotheses and analyses all line up clearly and that the student is confident about how the analyses are going to proceed. Ask yourself (and your supervisors(s) whether the project continues to be feasible and approximately on schedule (don't forget you made a Ganntt chart).

d. <u>Last third</u>

You now have introduction, methods and at least preliminary results. At this point you should **stop collecting data**. It is always tempting to collect more and more data. Don't succumb to this temptation: **rushing your write-up is a quick route to a lower grade no matter how good your data**. At a minimum, try and give yourself four weeks clear before the deadline to run final analyses and write your discussion. The last two are to **give your supervisor a fortnight before the deadline to look at your final complete draft**. You will need a couple of weeks to give them a chance to provide feedback and then to give you a chance to make changes.

2.2 MRes Biosystematics

Aims of the course

You will be provided with training in research techniques in systematics, taxonomy, evolutionary biology and bioinformatics, as a stepping-stone to a PhD or other research-related careers. The MRes will provide you with a solid grounding in a range of professional and transferable skills and a variety of specific research techniques. It provides the opportunity to make a more informed decision on the area of research and specific projects they wish to pursue.

On completion of the course, the student is expected to have:

- A solid theoretical background of modern biosystematics, together with relevant practical experience, in a range of key science areas of this discipline, including specimen-based analyses, phylogeny reconstruction, molecular systematics and genomics, and bioinformatics;
- A broad appreciation of the scientific opportunities provided by biosystematics to the study of biological diversity, including knowledge of latest technologies and developments in the theory of the discipline;

- Hands-on experience with a range of specific research techniques, in addition to professional and transferable skills of data handling and interpretation, critical thinking.

-
- The ability to perform as an independent scientist in the area of biosystematics and to contribute to the formulation and development of scientific projects in this field, including potential PhD projects in areas of interest;

Course structure

Each student will complete three ~13-weeks research projects during the year, at least one within an NHM Research Group laboratory and one at Imperial College. The projects should each cover one of the following topics: Bioinformatics, Molecular Systematics and Morphological Phylogenetics. Each project will culminate in a short report (3000 words) and a public presentation (20 minutes) to the NHM or Imperial academic communities, as appropriate.

Prior to the start of the projects, you will undertake four mandatory modules in statistics, computing, GIS and genomics at Silwood Park in the early parts of the Autumn Term and the Induction Week and Field Course at NHM. You will also attend a set of mandatory lectures offered on the MSc Taxonomy and Biodiversity specified in the MRes programme below. Students are invited to attend lectures and seminars in the weekly Imperial and NHM seminar series and other specialist subject seminars, many given by acknowledged international experts, together with a broad range of established courses within the College across all basic science disciplines, including particularly the MSc course in Taxonomy and Biodiversity. As Research Group members, students will participate in all group discussions, seminars, work-in-progress lab meetings, and journal clubs.

Project ideas could be the student's own, or can be developed together with potential supervisors and the course director. We maintain an online spreadsheet of available projects and new project proposals will be added to this throughout the year. The details of available projects can be found under these two links:

Webpage http://goo.gl/GWtgy6

Tab delimited text file http://goo.gl/awH7Vf

This list is by no means exhaustive but if any student wants to find out more about any of these projects, they are encouraged to discuss the projects with the supervisors named.

Student Teaching Record

MRes students are required to undertake a certain amount of formal learning, and to complete a report form at the end of the academic year. The following table gives a list of recommended lectures, practicals, seminars and transferable skills courses.

MSc LECTURES / PRACTICALS	
Phylogenetic Reconstruction module: Cladistics, characters, coding Optimization, weighting	
Methods in Macroecology and Macroevolution Macroevolution, macroecology Patterns of speciation	
Species and speciation Species concepts Intraspecific variation	
Molecular Systematics module: Variation in sequence data, alignment Overview of tree building methods Models of evolution and maximum likelihood	
Palaeobiology module: Stratigraphy and dating Phylogenetics Extinctions	

IMPERIAL COLLEGE LONDON – MASTERCLASS PROGRAMME	
Applied Writing Skills	Courses run by the Graduate School of Life Sciences & Medicine (GSLSM) in the Autumn and Spring terms only at Imperial College South Kensington. For course dates see Imperial College website
Creativity and Ideas Generation	
Writing for Publication	
Introduction to Regression Modelling	
Introduction to Statistical Thinking	

OTHER SEMINARS / TUTORIALS	
MRes Tutorials	To be held monthly, arranged by Alfried Vogler
NHM Departmental Seminars	Regularly held in each of the four Science Departments and announced by email
NHM / Imperial College Silwood Park	Lab meetings, seminars, journal club meetings
16th Young Systematists' Forum	25 November 2016, Flett Theatre, NHM See http://www.systass.org/ysf/ for details
CEE Seminar Series (Centre for Ecology and Evolution)	Wednesdays 5pm at UCL See http://www.ucl.ac.uk/~ucbtcee/ for details
LERN Meetings (London Evolutionary Research Network)	See http://londonevolution.net/ for details

2.3 Silwood

Silwood Park accommodation and day trips

During the courses at Silwood Park, all efforts will be made to provide housing in student accommodation on campus during the working week Monday to Friday. Students are expected to make their own way to Silwood and cover the cost of transport. For those with private transport it is possible to travel there on a daily basis from London. In addition, day trips may be organised to places of interest, and transport will be provided.

Silwood News is sent out by email three times a week. Much of the information is specific to students and staff based at Silwood, such as journal clubs, talks, accommodation etc. However, it is also a very useful source of information on PhDs, jobs, volunteer work, field trips etc.

Please subscribe to it using this link:

https://mailman.ic.ac.uk/mailman/listinfo/silwood-news

Additional participants

Some modules are offered as short courses in addition to being part of the MSc, and they are also recommended as part of the training of MRes and PhD students within the NHM. Therefore there may sometimes be a few extra people joining you, and we hope that you will make them feel welcome and show them the ropes if they have any problems.

2.4 Tutorials

The purpose of the tutorials is to give students an opportunity to discuss and explore any areas of a module within a small group. Students are encouraged to communicate with the module organiser for suggestions on format and content of the tutorial. Most tutorials will be built around papers from the primary literature.

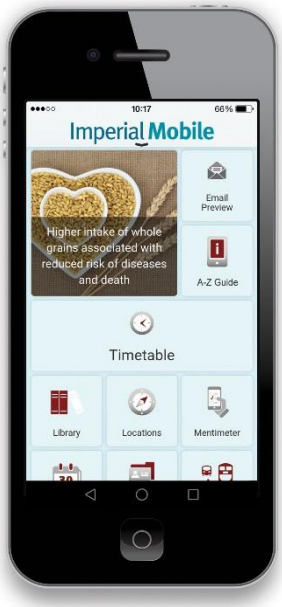
2.5 Personal tutors

All students will be assigned a personal tutor from whom they can seek advice with regards to academic work, projects, personal problems etc. Each student will be allocated a personal tutor at the start of the course, and an initial meeting will be arranged. Thereafter, students should approach their tutor as and when they feel it is necessary.

Imperial Mobile app

Don’t forget to download the free Imperial Mobile app for access to College information and services, including your course timetable, College emails and a library catalogue search tool.

www.imperial.ac.uk/imperialmobile



3. Assessment

3.1 MSc Taxonomy and Biodivesrity

The course comprises two elements, both of which must be passed with a minimum mark of 50% to obtain the degree of MSc in Taxonomy and Biodiversity. The first element comprises two components. The first component of the first element is the four items of course work, each of which is equally weighted in terms of marks and which collectively comprises 20% of the final degree mark. The second component of the first element is the combined examinations (two papers, each with two questions to be answered) which collectively constitute 40% of the final degree mark. The second element comprises the project which accounts for the remaining 40% of the final degree marks. In addition each student must give two oral presentations, both of which must be passed. Students shall be awarded a Pass degree if they have achieved a minimum of 50% in each of the two elements, and both components of the first element each achieve a minimum of 50%. Students will be awarded a Pass with Merit if their aggregate mark is greater than or equal to 60% and neither element mark is below 50%. Students will be awarded a Pass with Distinction if their aggregate mark is greater than or equal to 70% and neither element mark is below 60%.

Coursework assessments

During the course, you will be required to complete the following assessed work:

Code	Related Module	Format	Submission Date
TB1	Tree-of-Life	Essay	November 2016
TB2	Molecular Systematics	Report	December 2016
TB3	Palaeobiology	Report	February 2017
TB4	Macroecology	Practicals write-up	March 2017
	Exams		January 2017
	Exams		March 2017
	Project		September 2017
Oral 1	Oral Presentation One	Journal article of student's choice	February 2017
Oral 2	Oral Presentation Two	Student's research project	Early Sept. 2016

The Project write-up an submission guidelines

The write-up should be in the style of a scientific paper from a journal that it might be appropriate for submission to. The preferred Journal should be selected in consultation with your supervisor. By 'style' we mean the structure and how information is presented — you do not need to make it look like a journal paper, but it should have an abstract, introduction, methods, results, and discussion (possibly conclusions). If the results of your project are publishable, this approach will save much time and will provide valuable experience in paper writing. You may provide appendices (Supplementary Information) if necessary (for example, to provide detailed methods).

The thesis must contain the following two elements:

- *Cover Page*: The cover page must bear the project title, your name and the month and year of submission. In addition, the following text must appear at the bottom of the cover page:

A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science/Research at Imperial College London

Formatted in the journal style of the *Potato Journal*

Submitted for the MRes/MSc in XXXX

Obviously, insert your choice of journal and choose the appropriate degree course!

- *Declaration*: The first page inside the cover must provide a brief declaration of the contributions made by you and by others to your project. Key points to address are:
  - Was the data provided to you or did you collect or assemble it?
  - Were you responsible for data processing or cleaning, if required?
  - Were any mathematical models developed by you or by your supervisor?
  - What role, if any, did your supervisor play in developing the analyses presented?

Word limit. The thesis should not exceed 5,000 words in length (excluding figures, tables, references and appendices). For the MRes each of the three theses, the word limit is 3,000 words (excluding figures, tables, references and appendices). Note that excessive referencing will be as frowned upon as inadequate referencing!

Thesis content

Always aim to be clear and concise. The size of the thesis will vary according to the student and project, but aim to make it as short as necessary to describe the work done and to discuss it in a general context. However, do not omit relevant data and information such as experimental procedures. A common mistake is to assume that the reader knows the projects as well as you do and to leave out clear descriptions of the motivation and structure of your research.

There are a few ways in which your thesis is likely to differ from a typical scientific paper:

- You should make sure that you clearly state your aims/hypotheses/questions towards the end of your introduction.
- You should take care to explain everything adequately so that the examiners can see clear evidence of understanding of all the concepts and methods -- this might entail providing more detail or background in the introduction and methods than in a typical paper. However, some of this detail can be put in an appendix or supplementary material. For example, a molecular study might state in the Methods section of the main text that you extracted DNA according to a phenol/chloroform extraction protocol according to a particular reference. In the appendix,

you should then describe the steps of your lab protocol in sufficient detail that other people could reproduce this procedure by following your description. Another example would the mathematical derivation of an equation in the main text, or details of a computer algorithm.

- You should make clear what you did versus what you were provided with. For example, did you collect the data that you analyzed or were they provided to you by someone else? Did you build the bioinformatics pipelines yourself, or where you given one that you then used for the analysis of your data? Did you write all the simulation or analysis code yourself?

You should make sure to discuss limitations of your study and what future work you would do to address those limitations or any other questions raised by your work. In your project, most likely you will run out of time to complete everything you want to do. In most papers, the research would not be as time limited, so limitations can be addressed by further work.

The following guidelines on content include tips from Andy Purvis, author of over 100 scientific papers and referee of many more.

- Introduction. A good introduction should leave the reader with a clear idea of the problem to be tackled and looking forward to the more detailed sections to follow. It should include a section on the general way the problem has been approached. An essential concluding part of the introduction is to clearly define the aims of the research project and any hypotheses tested. Also, think about:
  - What is this paper about? (i.e., the broad area, big picture) Why is that interesting?
  - Given it's so interesting, why don't we know the answer?
  - So, what is this about, more specifically? What are hypothesised to be the important things? Build from the most general and fundamental hypotheses to the most refined or tenuous ones.
  - How, roughly and briefly, will you go about testing these hypotheses? Why are you using this system? What approach will you use?
  - State clearly what your hypotheses are. These are not usually stated explicitly in a paper.

- Methods. This should contain details of any methods used extensively during the project, layout of field experiments, theoretical methods, methods of statistical analyses etc. You can use subheadings for different procedures or tests. If field work is done, a general description of the study area may be included here. Extra methodological details can be placed in appendices. The golden rule is that the reader should be able to repeat what you did, should they so wish. The other rule -- more important for your project than in a paper -- is that you describe in enough detail to show you've understood what you did.

  You should feel free to use subheadings in your methods and results to help organise different parts of your project. If so, keep the same order of the different parts of the project in all of your sections: the methods for testing each hypothesis and the results of those tests are described in the same order as the hypotheses are described in the introduction. Also, think about:
  - What is the overall design of the study?
  - What are the variables and how do they relate to the hypotheses?
  - How did you get the data?
  - What are the characteristics of the data set / experiment -- how many observations, how many replicates etc.
  - General procedures, if any, that are true in all of the analyses (e.g., transformation of data, model checking, how models were compared)
  - How did you test the hypotheses, in the logical order outlined in the introduction (i.e., from the general to the specific)? Make sure you show that your tests are appropriate.

- Results. Describe your results in a logical order: this may not necessarily be the order in which you did the experiments. Briefly summarise the main results at the end of each main experiment or sequence of associated experiments. Do not duplicate results -- put a table or a graph but

not both unless the two methods of presentation demonstrate different points of importance. You must refer appropriately to figures or tables in the text and remember to emphasise and perhaps quote significant results. In particular, think about:
  - What were the results of your hypothesis tests, in the order you describe them in the Methods?

- Discussion.This should attempt to tie together the results, what they indicate in a broader context, the extent to which the original aims have been satisfied and what future work is suggested. Return to and address the ideas raised in the introduction. In particular, think about:
  - What's the main thing we know now that we didn't know before?
  - What's the chain of logic and results that means we know it?
  - How does this affect our -- and other scientists' -- view of the world? What are the implications?
  - What are the implications of the intermediate steps in the chain towards the main thing?
  - What are the caveats that apply to this study? (Leave out caveats that apply to all studies.) What might be done about them? (Very important in a project write-up -- What would you do differently if you were doing the project again or had more time?)
  - What future work could build more broadly on what we've found?
  - A nice wrap-up, emphasising how this study in this system is of interest to people who work on other things, or other systems.

- Abstract. Now, and only now, write the abstract, making sure it includes the key point from each of the tips above. Don't rush the abstract -- it is your first opportunity to tell a reader about the research and a clear, concise abstract sets them up to understand your work!

- References. Make sure all cited references appear in this list at the end of the thesis using the standard style from your chosen journal. If you are using LaTeX, use BibTex, of course! If you are using a WYSWYG editor like MS Word, use bibliographic software (e.g. Mendeley) to manage and format your citations. In particular, note that you can use Mendeley to output *.bib files that you can use in LaTeX.

- Appendices or Supplementary Information. The days of the conventional appendix are numbered. Large sets of data (e.g. census results, 'raw' experimental results) should go into "Supplementary Information" (SI) if these are of value, e.g. indicating an interesting range of variation. All summary tables or graphs and outline results of analysis should be put in the text. Any useful parts of the study not directly relevant to the main theme may also be put in a section under the SI (e.g. taxonomic descriptions and drawings in an otherwise ecological study).

- Computer Programs. If the program has been published, cite the reference, include it in the reference list and provide a brief outline of the methods it uses. If you are using a program or code generated for the project then a more complete description is needed in the main text. You should provide the code used in an appendix and consider providing a flow chart and usage notes to help interpretation. You should take care to define all the input variables used in the program.

- Figures. You should prepare figures to the same standard required for publication. All journals provide advice on preparing figures for publication, so do look at the advice to authors pages for your chosen journal. All figures must be numbered and have a caption that is sufficiently detailed to explain the main features of the content by itself. All figures must be referred to in the main text of the thesis. Put the figures in appropriate points in the text, close to the text that refers to them. In particular:

- The resolution of your figures is crucial. For plots, try to use vector image formats (exported as svg, pdf, or eps) and not bitmapped (raster) formats like JPG and TIFF. Standard /LaTex documents typically allow *.eps or *.pdf figures to be inserted. Using the freely available (and very capable!) vector graphics program Inkscape to ``fine-tune'' your figures is often a good idea. Inkscape will also allow svgs to be exported in a /LaTex compatible format (see the Inkscape documentation). For RASTER graphics, the freely available GIMP editor works very well.
- When using Word, figures in Windows Metafile format are the most reliable vector format. For Word 2011 on Mac, figures in PDF format should give a good result. If you do have to use bitmaps, make sure they are at a high resolution (300 dpi or more) -- this can be particularly important if you need to present line drawings or photographs of specimens or equipment.
- Plots are all about the data, so reduce margins and maximise the space in the figure for showing the data.
- Create the figure at the right size -- when it is included in your thesis are all the axis labels and text going to be clearly legible.
- Avoid `chartjunk' (google Edward Tufte!) -- and avoid superfluous lines, legends and titles along with 3D effects.

- Tables. Each table should be numbered, have a full descriptive caption and again must be referred to in the main text. Column headings should state units of measurement. Avoid large, complicated tables in the main thesis and if you have a large body of numerical data put it in an appendix.

Thesis printing and submission

Your dissertation should be submitted in a pdf format.

Presentation

As word processing systems and laser printers are readily available, these should be used where possible. A4 is the standard size. The main body of the text should be printed using 1.5 line spacing, and page numbering should be used.

Binding the Thesis

Use a comb binder to bind the thesis. The front cover should be cellophane, the back plain white card. The title, etc., must be displayed on the first page.

How many copies

MSc students must produce three bound copies of the thesis, two of these must be handed in on the specified date (see below), and the third copy you must take with you to your viva examination. Of the two copies which you hand in, one will eventually go to your supervisor, and an electronic copy to Imperial College Library.

MRes students must produce three bound copies of the thesis, two of these must be handed in on the specified date (see below), and the third copy you must take with you to your viva examination. Of the copies which you hand in, one will eventually go to your supervisor, and an electronic copy to Imperial College Library.

Handing in for MSc students

The deadline for submission of the project is Monday 4 September 2017. Any theses received after this time will result in a downgrading of marks. Hardcopies of the theses must be handed into the School Office by 12:00pm on Tuesday 5 September and an electronic copy submitted by the deadline of Monday 4 September 2017 at 5:00pm.

Handing in for MRes students

The deadlines for each of the three projects will be January 2017, May 2017 and September 2017; the exact dates will be given nearer the time. Any theses received after the specified dates will result in a downgrading of marks. Hardcopies of the theses must be handed into the School Office and an electronic copy submitted by the deadline.

3.2 MSc course regulations

The following notes outline the Department of Biological Science's rules for awarding MSc Degrees (2008 edition – updated September 2011). The University's General Regulations and the College's Special Regulations should be consulted in all cases of doubt.

Course credit requirements

The scheme outlined is that accepted formally by the University and by Imperial College London for the award of *MSc in Taxonomy and Biodiversity*.

[All modules are compulsory]

Class Boundaries

The final degree mark will be used to classify MSc degrees according to the following notional boundaries:

Distinction 70% or more

Merit 60% or more (less than 70%)

Pass 50% or more (less than 60%)

Fail below 50%

These boundaries are moderated at the Examiners' Meeting to take account of your performance over the year and any difficulties you may have experienced (such as illness).

Taught Modules

Certain modules are assessed by a combination of a written examination and coursework, consisting of assessed essays, reports or practical class write-ups.

Coursework

Receipt of marks for assessed coursework is absolutely dependent upon the student delivering the work by the stated deadlines (making due allowance for sickness). Marks for assessed practical class reports can be gained only if you attend and perform the relevant practicals.

Research Projects

Assessment will be by written report and viva voce after the completion the project.

a) The project report will be marked by the Supervisor and a Marker who is a member of research staff at Imperial or NHM familiar with the relevant scientific field.

b) The Supervisor and Marker independently assess the thesis (report) for a preliminary mark. They will then agree a mark.

1. c) The Supervisor and Marker and Assessor should each add a written justification of their marks to Forms I and II, to inform the External Examiners and to provide feedback to the students.

2. d) In the case of the Supervisor and Marker differing in 10% or more in their mark, a third person, usually one of the Course Directors, will also assess the thesis and a thesis mark will be assigned based on agreement among the three markers.

External Vivas

Each candidate will be interviewed on his/her project by the External Examiner, the purpose being to reveal any problems the candidate may have had with the project, and to probe their understanding of the research they undertook. There is no mark attached to the viva with the external examiner, but the examiner will take part in moderation discussions and use the feedback from students in assessing the quality of the course.

Resit Examinations

a) If you should fail the examination you are entitled to resit it the next two times it is offered;

1. b) if the course work element failed to reach the threshold 50% mark, whether through inadequacy or lateness of submission, the student will normally be asked to repeat the specific failed course components (i.e. take them again);

2. c) a candidate who has attended most of a course but fails its coursework element because of ill health or bereavement will normally be allowed to resubmit the relevant coursework by a new deadline;

3. d) a candidate who has taken a course but fails to sit its exam because of ill health or bereavement will normally be allowed to carry over their coursework mark for that course to when they next take the exam.

3.3 MRes Biosystematics Degree Regulations

The course comprises three elements, each of which must be passed with a minimum mark of 50% to obtain the degree of MRes in Biosystematics. Each element contributes an equal proportion to the final mark. Each element comprises two components. The components include a written thesis and oral presentation, whose marks contribute 75% and 25%, respectively, to a preliminary mark for this element. Students shall be awarded a Pass degree if they have achieved a minimum of 50% in all three elements. Students will be awarded a Pass with Merit if their aggregate mark is greater than or equal to 60% and no element mark is below 50%. Students will be awarded a Pass with Distinction if their aggregate mark is greater than or equal to 70% and no element mark is below 60%. More detailed degree regulations are provided in the back of the course handbook.

Marking criteria for exams and essays

The following criteria should be used to mark both exam answers and coursework essays.

Literal Grade	**Criteria** (Problem type answers should be marked on a semi-absolute scale)
A*	**Exceptional.** Answer is an exceptionally well presented exposition of the subject, showing: (i) command of the relevant concepts and facts, (ii) a high critical or analytical ability**, (iii) originality, and (iv) evidence of substantial outside reading (where applicable).
A	**Excellent.** Answer is a very well presented exposition of the subject, showing many of the above features, but falling short in one or two of them.
B	**Good.** Answer (i) shows a clear grasp of the relevant concepts and facts, (ii) gives an accurate account of the relevant taught material *(as exemplified in the model answer),*and (iii) shows evidence of some outside reading *or* of critical or analytical ability**.
C	**Adequate.** Answer: (i) shows a grasp of the basic concepts and facts, (ii) gives a mainly accurate account of at least half of the relevant taught material *(as exemplified in the model answer),*and (iii) does not go beyond that, *or* goes beyond that but is marred by significant errors.
D	**Fail.** Answer shows only a weak grasp of the basic concepts and facts, and is marred by major errors or brevity. Answer shows a confused understanding of the question, contains major errors and information which is irrelevant to the question and/or is too brief to indicate adequate knowledge of the subject. Answer is too inaccurate, too irrelevant, or too brief to indicate more than a vague understanding of the question. Answer presents only two or three sentences or facts that are correct and relevant to the questions. Answer includes at most one sentence or fact that is correct and relevant to the question. Answer contains nothing correct that is relevant to the question.

** *Analytical* = assessing a hypothesis or statement by breaking it down into its elements and examining their inter-relationships and contribution to the whole; cf. *Critical* = judging a hypothesis or conclusion by examining the validity of the evidence adduced for it.

SUGGESTED FRAMEWORK FOR COURSEWORK ASSESSMENT

Grade	Criteria (Problem-type answers should be marked on a semi-absolute scale)
A*	**Exceptional.** All procedures understood and applied properly, with a clear and logical write-up. Evidence of background reading, detailed discussion of methodology and results, full statistical analysis (where relevant), analysis of errors (where relevant), clear conclusions.
A	**Excellent.** All procedures understood and applied properly, with a clear and logical write-up.
B	Good. Most procedures understood and mostly applied properly with a few minor problems.
C	**Adequate.** A few procedures misunderstood but important ones grasped.
D	Fail. Shows only a weak grasp of the basic concepts and facts and is marred by major errors or brevity. Shows a confused understanding of the work required with less than one third of the material expected. Answer is too inaccurate, too irrelevant or too brief to indicate more than a vague understanding of the question. Presents only two or three sentences or facts that are correct and relevant. Includes at most one sentence or fact that is correct and relevant. Contains nothing correct that is relevant.

Note: These criteria are not necessarily suitable for all coursework.

MSc and MRes PROJECT ASSESSMENT – THESIS MARKING CRITERIA

Literal **Grade**	**% Grade**	**Criteria**
A*	100 95 90 85	**Exceptional.** Thesis is of a publishable standard**. It is an exceptionally well presented exposition of the project, showing: (*i*) command of the relevant concepts and facts, (*ii*) a high level of analysis, (*iii*) originality in thought and experimental design, and (*iv*) mastery of the relevant literature.
A	80 76 72	**Excellent.** Thesis is written to a publishable standard** with minor revision. It is a very well presented exposition of the project, showing most of the above features, but falling short in one of them.
B	68 65 62	**Very Good to Good.** Thesis contains potentially publishable material**, but needs revision of the text and further research. It is otherwise a well presented exposition of the project, showing: (*i*) a clear grasp of the relevant concepts and facts, (*ii*) appropriate, though not highly sophisticated analysis, and (*iii*) a sound knowledge of the relevant literature.
C	58 55 52	**Adequate.** Thesis is not written to a publishable standard and requires major revision and substantially more research. It is an adequately presented exposition of the project, showing: (*i*) a grasp of the basic concepts and facts, (*ii*) an adequate use of statistics in its analyses, and (*iii*) sufficient knowledge of the relevant literature to set its results in a scientific context.
D	48 45 42	**Unsatisfactory.** Thesis is an incomplete presentation of the project and is marred by major errors or gaps, missing analysis, lack of references, misconceptions, excessive brevity, etc, at most showing a weak grasp of the basic concepts and facts.
	35 30 25	Thesis as above, but presentation extremely poor and overall impression indicates a very weak grasp of the basic concepts and facts.
	20 15 10	Thesis as above, and in addition no real attempt to analyse data or present results in a scientific manner.
	5	Thesis as above but incomplete and lacking understanding in all areas.
	0	Thesis not produced.

** This publishability assumes that the data are *per se* worth publishing.

College's Academic and Examination regulations:

www.imperial.ac.uk/about/governance/academic-governance/academic-policy/exams-and-assessment

Penalties for Late Submission of Assessed Work:
www.imperial.ac.uk/media/imperial-college/administration-and-support-services/registry/academic-governance/public/academic-policy/marking-and-moderation/Penalties-for-late-submission-of-assessed-work.pdf

Mitigating circumstances policy and procedures:
www.imperial.ac.uk/about/governance/academic-governance/academic-policy/exams-and-assessment/

College policy on exams and religious obligations:
www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/exams-and-religious-obligations

Plagiarism

Plagiarism is the presentation of another person's thoughts, words, images or diagrams as though they were your own. Another form of plagiarism is self-plagiarism, which involves using your own prior work without acknowledging its reuse.

Plagiarism is considered a cheating offence and must be avoided, with particular care on coursework, essays, reports and projects written in your own time and also in open and closed book written examinations.

Where plagiarism is detected in group work, members of that group may be deemed to have collective responsibility for the integrity of work submitted by that group and may be liable for any penalty imposed, proportionate to their contribution.

The use of the work of another student, past or present, constitutes plagiarism. Where work is used without the consent of that student, this will normally be regarded as a major offence of plagiarism.

In your report you must explicitly identify any results obtained by others. If you worked jointly with a member of the group to obtain a particular result, this should be stated.

Occasionally a paper describing your project work will have been submitted to a conference or a journal prior to you submitting your report. You cannot use the text from this paper – you must rewrite this for your report - even if you wrote the original paper. You should discuss this with the course Director or Deputy Director.

For further information, please refer to the Cheating Offences Policy and Procedures section on page 21 of this handbook.

All Master's students will be required to self-enrol onto the course which is available via Blackboard. Instructions on how to enrol onto the course can be found on the Graduate School's Plagiarism Awareness Online Course webpage
http://www3.imperial.ac.uk/graduateschool/plagiarismawarenesscourse

The course will take approximately 1.5 hours to complete but can be saved and returned to at a later date. There is no limit to the amount of times students can take the course – it can be accessed anytime, so there will always be an opportunity to refresh understanding.

3 Board of examiners

Board of Examiners

Professor Alfried Vogler
Dr Ian Kitching
Dr Mark Carine
Dr Martin Bidartondo

For external examiners

tbc

It is common for Master's level students to have some form of academic or social interaction with their external examiners at some point during or after their studies as well as during the assessment process itself.

It is inappropriate for you to submit complaints or representations direct to external examiners or to seek to influence your external examiners. Inappropriate communication towards an examiner would make you liable for disciplinary action.

External examiners reports can be found here:

www.imperial.ac.uk/staff/tools-and-reference/quality-assurance-enhancement/external-examining/information-for-staff

4 Location and facilities

Imperial has a number of campuses in London and the South East. All have excellent travel links and are easily accessible via public transport.

Your main location of study will be The Natural History Museum and Silwood Park. Whilst at the South Kensington Campus, you have access to the following facilities.

Computer access and printing is available at 310/311, Floor 3, Sir Ernst Chain Building. The Department's postgraduate office is located at Room 202, Sir Ernst Chain Building and open Monday to Friday, 09.00 – 17.00.

The PG common Room is on Floor 7 of Sir Ernst Chain Building.

Facilities for when you are your project rotation is confirmed nearer the time.

Maps

Campus maps and travel directions are available at:

www.imperial.ac.uk/visit/campuses

http://www.nhm.ac.uk/content/dam/nhmwww/visit/Galleriesandfloorplans/Natural%20History%20Museum%20map.pdf

http://www.imperial.ac.uk/media/imperial-college/visit/silwood/public/silwoodmap.pdf

Accessibility

Information about the accessibility of our South Kensington Campus is available online through the DisabledGo access guides:

www.disabledgo.com/organisations/imperial-college-london-2

Postgraduate activities @ NHM

There are currently more than 200 M.Phil students, PhD students and postdoctoral scientists who are affiliated with the Natural History Museum. The Museum has student representatives and also staff members who act as student co-ordinators in each department.

Every effort is made to unify all postgraduate students who are based at the NHM for much of their studies, and to try to build up a student community. The MSc and MRes students are an

important part of the student buzz and as such we really want you to feel part of the Museum as a whole, and most importantly, feel part of the student community at the NHM.

To these ends a student website has been established, which you are actively encouraged to use as a noticeboard for anything – pub meetings, finding a squash partner ... it's your page and up to you what you want to put on it. The page lists info on training courses, job opportunities and also the "cheapo" deals you can get using your museum pass – free entry to galleries and museums, half price theatre tickets etc.

Check out the web page: http://intranet.nhm.ac.uk/infostore/intrarco/postgrads/index.htm

Security passes and keys @ NHM

All MSc and MRes students will be issued with a Museum security pass, valid for one year. The pass allows students to be in the Museum between 07:00 and 19:30 each weekday. Please note that this pass must be worn and be visible at all times whilst in the Museum. Students will be issued with a DVS11 key that allows entrance to the teaching rooms, libraries and other non-public areas.

Emergency evacuations

Any announcements made concerning emergency evacuations must be obeyed. If instructed, please leave the Museum immediately, without stopping to collect personal belongings. The muster point for occupants of the Upper and Lower Bridge Rooms is the back car park, directly outside the Control Room.

Out of hours working

Students must leave the Museum premises by 19.30 in the evening, and will not be admitted before 07:00 in the morning on weekdays. Students wishing to stay later than 19:30 must phone the Control Room to inform security and sign out when they leave (Ext.5888). Students who wish to gain access to non-public areas of the Museum at weekends and on Bank Holidays can do so only from 09:30 until 19:00 – they must sign in and out, inform security of where they will be working in the Museum, and cannot be accompanied by anyone who does not hold a Museum pass.

Museum seminars

Several series of seminars are organised within the Natural History Museum. These include Departmental ones (e.g. Life Sciences and Earth Sciences) and topic based (e.g. Systematics). MSc and MRes students are welcome to attend any of these and are strongly encouraged to do so. Details about forthcoming seminars are generally advertised on global emails.

Museum libraries

A talk and tour of the Museum libraries will be given at the start of the course. MSc students are allowed to take library books and journals out of the libraries, once they have filled in a black bookboard. Any books, journals etc. borrowed from the Libraries must be kept in the UBR cupboard on the shelf marked "Library Materials", or in their project supervisor's office, with the location clearly marked on the bookboard. Under no circumstances are books, journals, etc. to be removed from the Museum premises, without completing the overnight loan book located in the Library. Inter-library loans can only be organised through your project supervisor. The Library Services Team will be able to answer any queries about the Library and its facilities - contact the Library on 020 7942 5460 or via email at: library@nhm.ac.uk.

A set of reference books has been purchased for use by the students, and a single copy (to comply with copyright legislation) of most cited references are also provided for the class. These will be kept in the cupboard in the Upper Bridge Room. Please do not abscond with these; they are the property of the class as a whole and not of any single individual.

The Upper Bridge Room

Most of the MSc lectures will be held in the Upper Bridge Room (EG482), located within the Earth Galleries. The room has an internal telephone, extension 7076. Lockers are provided for use by the students, and a £5 returnable deposit is given for keys. Valuables should not be left in the room unattended at any time, as neither the Museum nor the College will be liable for any loss or damage incurred, and you are therefore asked to keep it locked when unattended, both at night and during the day.

The Lower Bridge Room

Most of the MSc practicals will be held in the Lower Bridge Room (EG 280), located within the Earth Galleries. The room has an internal telephone, extension 6880. The room holds a large number of computers, and you are therefore asked to keep it locked when unattended, both at night and during the day. Valuables should not be left in the room unattended at any time, as neither the Museum nor the College will be liable for any loss or damage incurred.

Computers

The Lower Bridge Room has a number of networked PC computers for the exclusive use of the MSc and MRes students. The various software that you will need for the MSc course is already installed. It is expected that the students will make full use of these computers in order to complete their practicals, etc. Students are strongly recommended to keep back-up copies of their personal data and text files on their own memory sticks or external hard drives.

In the event of any computer hardware/software problems, please contact the Museum's IT Helpdesk on extension 6000 or e-mail itsupport@nhm.ac.uk, giving them the location and number of the computer. There is a printer/scanner/photocopier in the Lower Bridge Room which is networked to the computers there. This is managed and serviced by an external company, and an automatic notification is sent if the toner runs low. Paper for the printer can be ordered via the Intranet portering service or from the Life Sciences Department.

N.B. You should not install your own software without permission; all software installed must be covered by the appropriate licences. Any unauthorised software will be removed. Specifically, do not download software from the internet without permission.

Email/intranet

NHM email addresses will be provided for all students, which you should check regularly for updates, information on assessments, exams etc. Two group email addresses are used to contact the students: msc-students@nhm.ac.uk and mres-students@nhm.ac.uk. Please feel free to use these if you wish to organise social events etc.

You will also have access to the Museum Intranet, and will each be allocated a personal folder in your name. We suggest you store your work here, as it is backed up every evening automatically, so there will be less risk of you losing your work! There is also a folder on the Museum server \\Amber\entom\MSc specifically for use by the MSc/MRes students, where information such as lecture notes, reading lists, practical datasets etc. can be accessed.

Health & safety

The Health and Safety Unit of the Natural History Museum provides a complete health, safety and fire advisory service. The Unit offers support to all departments when and where it is needed on the basis of risk assessment and having regard to the Museum's priorities as laid down in the Corporate Plan.

Details can be found at:
http://intranet.nhm.ac.uk/resources/healthandsafety/healthandsafety_home.htm

Students should be aware that when working in NHM laboratories they will be required to adhere to all H&S regulations. If undertaking fieldwork as part of their project research, they will be required to complete a risk assessment form and an official absence form in order to be covered by the NHM Insurance Policy.

Useful contacts

Most information can be found on the NHM Intranet, but the following gives a few useful pointers.

Computer problems: Ring the IT helpdesk on Ext. 6000, then press 2

- Estates department: Ring the Estates department on Ext. 6000, then press 4
- Security: Ring the Control Room on Ext. 5888
- In an emergency: Ring Security on Ext. 6666
- Removal of waste: Contact the Porters via the intranet (Forms – General)
- Photocopying: Contact Lorraine Portch, photocopy unit on Ext. 5647 or lorp@nhm.ac.uk
- Paper/print cartridges: Collect from Life Sciences Department

5 Working while studying

If you are studying full time, the College recommends that you do not work part-time during term time. If this is unavoidable we advise you to work no more than 10–15 hours per week, which should be principally at weekends and not within normal College working hours.

Working in excess of these hours could impact adversely on your studies or health.

If you are here on a Tier 4 visa you can work no more than 20 hours a week during term time. Some sponsors may not permit you to take up work outside your studies and others may specify a limit.

If you are considering part-time work during term time you are strongly advised to discuss this issue with your supervisor or Postgraduate Tutor. If you are on a Tier 4 visa you should also seek advice from the International Student Support team regarding visa limitations on employment.

Please refer to our policy on working while studying:

www.imperial.ac.uk/media/imperial-college/faculty-of-engineering/bioengineering/public/student/Student-Employment-During-Studies.pdf

6 Health and safety

You are responsible for looking after your own health and safety and that of others affected by your College-related work and leisure activities. You must:

- comply with all local and College policies, procedures and codes of practice and with the arrangements which the College has in place to control health and safety risks.
- ensure that your activities do not present unnecessary or uncontrolled risks to yourself or to others.
- attend appropriate induction and training.
- report any accidents, unsafe circumstances or work-related ill health of which you become aware to the appropriate person.
- not interfere with any equipment provided for Health and Safety.
- inform your supervisor or the person in charge of the activity in cases where you are not confident that you are competent to carry out a work or leisure activity safely, rather than compromise your own safety or the safety of others.

The College's Health and Safety Policy can be found at:

www.imperial.ac.uk/media/imperial-college/administration-and-support-services/safety/internal/policies/Health-and-Safety-Policy-Statement-May-2015---re-signed-by-Provost.pdf

Your Departmental safety contact is:

Stefan Hoyle

Faculty of Natural Sciences

Head of Health and Safety

5th Floor Sir Alexander Fleming Building South Kensington Campus, London SW7 2AZ

07872850018

s.hoyle@imperial.ac.uk

You may be required to complete inductions and attend training sessions to safely complete this course. These include:

5th Oct - Safety Primary Induction Session (South Kensington) - 15:30 – 16:30

The College Safety Department

The Safety Department offers a range of specialist advice on all aspects of safety. This includes anything which you feel might affect you directly, or which may be associated with teaching, research or support service activities.

The College's activities range from the use of hazardous materials (biological, chemical and radiological substances) to field work, heavy or awkward lifting, driving, and working alone or late.

All College activities are covered by general health and safety regulations, but higher risk activities will have additional requirements.

The Safety Department helps departments and individuals ensure effective safety management systems are in place throughout the College to comply with specific legal requirements.

Sometimes the management systems fail, and an accident or a near-miss incident arises; it is important that we learn lessons from such situations to prevent recurrence and the Safety Department can support such investigations. All accidents and incidents should be reported online at:

 www.imperial.ac.uk/safety

To report concerns or to ask for advice you should contact your programme director, academic supervisor or departmental safety officer in the first instance. You may also contact the Safety Department directly.

Occupational Health requirements

The College Occupational Health Service provides services to:

- protect health at work
- assess and advise on fitness for work
- ensure that health issues are effectively managed

The Service promotes and supports a culture where the physical and psychological health of staff, students and others involved in the College is respected, protected and improved whilst at work.

 www.imperial.ac.uk/occupational-health

7 College policies and procedures

Regulations for students

All registered students of the College are subject to the Regulations for Students, the College Academic and Examination Regulations and such other regulations that the College may approve from time to time.

www.imperial.ac.uk/about/governance/academic-governance/regulationswww.imperial.ac.uk/students/terms-and-conditions

Appeal and complaints procedures

We have rigorous regulations in place to ensure assessments are conducted with fairness and consistency. In the event that you believe that you have grounds for complaint about academic or administrative services, or wish to appeal the outcome of an assessment or final degree, we have laid out clear and consistent procedures through which complaints and appeals can be investigated and considered:

www.imperial.ac.uk/about/governance/academic-governance/academic-policy/complaints-appeals-and-discipline

Academic integrity

You are expected to conduct all aspects of your academic life in a professional manner. A full explanation of academic integrity, including information on the College's approach to plagiarism is available on the Student Records and Data website:

www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/plagiarism-academic-integrity--exam-offences

Cheating offences policy and procedures

It is important that you learn how to properly attribute and acknowledge the work, data and ideas of others. Plagiarism is scientific misconduct, and students whose assessments can be shown to contain plagiarism are subject to penalties as outlined in the College's Cheating Offences Policy and Procedures – see Appendix 3 of the Examination Regulations which can be found here:

www.imperial.ac.uk/about/governance/academic-governance/regulations

Intellectual property rights policy

For further guidance on the College's Intellectual Property Rights Policy, please contact the Research Office:

www.imperial.ac.uk/research-and-innovation/research-office/ip

Use of IT facilities

View the Conditions of Use of IT Facilities:

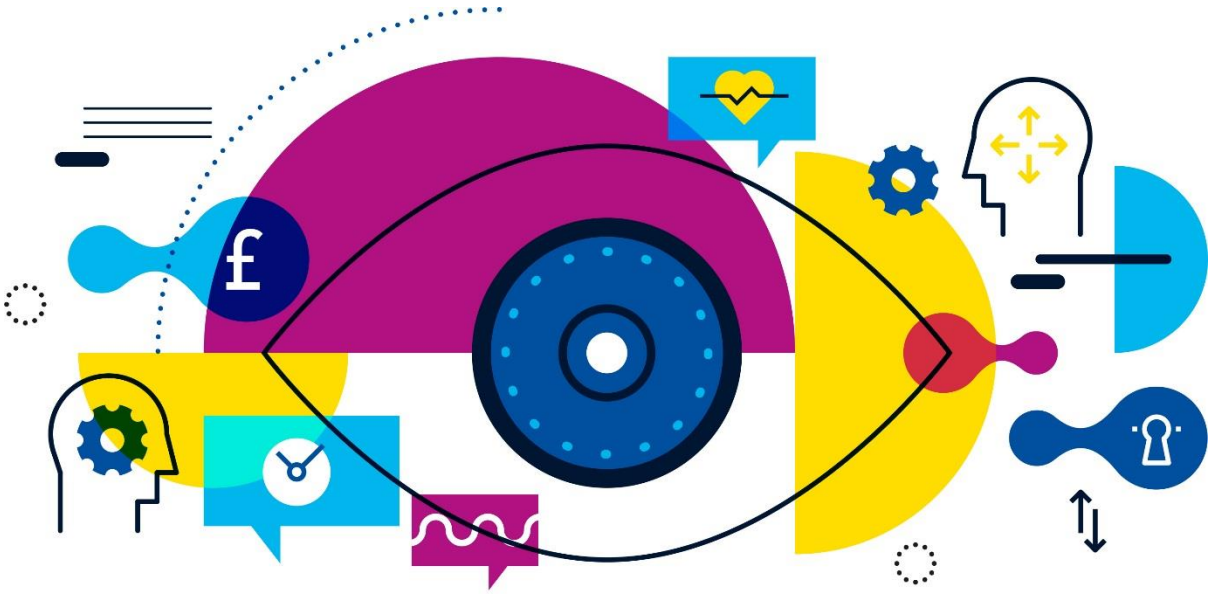
www.imperial.ac.uk/admin-services/secretariat/college-governance/charters-statutes-ordinances-and-regulations/policies-regulations-and-codes-of-practice/information-systems-security/iss-policies/policy2/

8 Well-being and advice

Student Space

The Student Space website is the central point for information on health and well-being.

www.imperial.ac.uk/student-space



Director of Student Support

The Director of Student Support has overall responsibility for all matters relating to student support and well-being.

www.imperial.ac.uk/people/d.wright

Departmental support and College tutors

Your Department has a system of academic and pastoral care in place to make sure you have access to the appropriate support throughout your time here. This includes:

Postgraduate tutor

The Department's postgraduate tutor can offer pastoral support and advice. You can arrange to have a meeting with him/her at any time during your studies – what you discuss will be completely confidential.

If necessary they will direct you to an appropriate source of support.

Neil Fairweather is the Postgraduate tutor for the Department of Life Sciences.

College tutors

College tutors operate outside of any department. They provide guidance and assistance to students in regard to welfare issues and are also involved in College disciplinary matters involving students. For more information see:

www.imperial.ac.uk/student-space/here-for-you/college-tutors-and-departmental-support

Advice services

The tutor system is complemented by a College-wide network of advice and support. This includes a number of specialist services.

Careers Service

The Careers Service has strong links to your Department and you will have a named Careers Consultant and Placement and Internship Adviser who will run both group sessions and individual meetings within your Department. You can arrange to meet with your linked Careers Consultant or Placement and Internship Adviser either in your Department or centrally on Level 5 Sherfield where the Careers Service is based.

Visit the Career Service's website to:

- Book a careers appointment
- Find resources and advice on successful career planning

www.imperial.ac.uk/careers

Counselling and Mental Health

The Student Counselling and Mental Health Advice Service offers short-term counselling to all registered students. The service is free and confidential. Counsellors are available at the South Kensington, Hammersmith and Silwood Park Campuses.

www.imperial.ac.uk/counselling

Financial support and tuition fees

If you've got any questions about student financial support (loans, scholarships and research council studentships, US and Canadian loans) then contact the Student Financial Support team:

020 7594 9014

student.funding@imperial.ac.uk

If you suddenly find yourself in financial difficulties or experience an unexpected change in circumstances, you may be eligible to apply for emergency financial help through the Student Support Fund. The Fund offers a one-off payment of up to £2,000 to cover such emergencies as last minute accommodation and travel necessities, equipment and childcare. It does not have to be repaid.

www.imperial.ac.uk/students/fees-and-funding/student-support-fund

For tuition fees queries, contact the Tuition Fees team:

020 7594 8011

tuition.fees@imperial.ac.uk

Imperial College Union (ICU) Advice Centre

Imperial College Union runs the Advice Centre independently of the College with advisers on hand to provide free, confidential, independent advice on a wide range of welfare issues including housing, money and debt, employment and consumer rights, and personal safety.

www.imperialcollegeunion.org/advice

Student Hub

The Student Hub represents a single point of contact for all key administrative information and support. The Student Hub team can help you with enquiries about:

- Accommodation (including checking contracts for private accommodation)
- Admissions
- International student enquiries
- Research degrees
- Student financial support
- Student records
- Tuition fees

Level 3, Sherfield Building, South Kensington Campus

020 7594 9444

student.hub@imperial.ac.uk

www.imperial.ac.uk/student-hub

Health services

NHS Health Centre and finding a doctor

Even if you're fit and healthy we recommend that you register with a local doctor (GP) as soon as you arrive in London. For help finding your nearest GP see the Student Space website:

www.imperial.ac.uk/student-space/here-for-you/find-a-doctor

There is an NHS Health Centre on our South Kensington Campus which you may visit during clinic hours if you're feeling unwell. Students living within the practice catchment area are encouraged to register with the Centre.

www.imperialcollegehealthcentre.co.uk

NHS Dentist (based in the Health Centre)

Imperial College Dental Centre offers a full range of NHS and private treatment options.

www.imperial.ac.uk/student-space/here-for-you/dentist

Disability support

Disability Advisory Service

The Disability Advisory Service provides confidential advice and support for all disabled students and students with specific learning difficulties.

If you think you may have dyslexia or another specific learning difficulty but have never been formally assessed, the Disability Advisory Service offers initial screening appointments.

Room 566, Level 5, Sherfield Building, South Kensington Campus

020 7594 9755

disabilities@imperial.ac.uk

www.imperial.ac.uk/disability-advisory-service

Departmental Disability Officers

Departmental Disability Officers are the first point of contact within your department. They can apply for additional exam arrangements on your behalf, and will facilitate support within your Department.

Neil Fairweather is the DDO for DoLS.

More information on Departmental Disability Officers is available at:

www.imperial.ac.uk/disability-advisory-service/support/ddos

More information on procedures for the consideration of additional exam arrangements in respect of disability is available at:

www.imperial.ac.uk/media/imperial-college/administration-and-support-services/registry/academic-governance/public/academic-policy/exam-arrangements-and-re-sits/Exam-arrangements-in-respect-of-disability.pdf

Library and IT

Information and Communications Technologies (ICT)

If you're having problems with technology (including computers, laptops and mobile devices), you can get help from ICT's Service Desk.

020 7594 9000

www.imperial.ac.uk/ict/service-desk

Software shop

The Software shop offers a variety of general and subject specific software programs and packages for free or at a discounted price for Imperial students.

www.imperial.ac.uk/admin-services/ict/shop/software

Library services

The Central Library at South Kensington is open around the clock pretty much all year. Make sure you find out who your departmental librarian is as they'll be able to help you find resources for your subject area. Also, don't forget to check out the Library's range of training workshops and our other campus libraries for access to specialist medicine and life sciences resources. Alongside these physical spaces and resources, the Library provides over 170,000 electronic books, journals and databases available both on and off campus and a free document delivery service to help you source books and articles from around the UK and the rest of the world:

www.imperial.ac.uk/library

Religious support

The Chaplaincy Multi-faith Centre has chaplains from many different religions, as well as prayer rooms and information on places of worship. In addition, it runs meditation classes and mindfulness workshops for stress management. There is a student-run Islamic prayer room on campus and separate areas available for male and female Muslims.

www.imperial.ac.uk/chaplaincy

Support for international students

English language support

The Centre for Academic English provides free in-sessional English courses for international students while they are studying. These include classes and workshops on academic language, social language, the four skills of reading, writing, listening and speaking, 1-1 consultations with a tutor to work on a piece of academic writing or an oral presentation, self-study resources in the VLE Blackboard, and the Conversation Project, which partners students with a native-speaker volunteer to practise social and conversational English.

www.imperial.ac.uk/academic-english

International Student Support team

Students from outside the UK make up around half of our student population, so our International student Support team offers year-round support to help our international students settle into Imperial life. This includes UK visa and immigration advice and trips to different places of interest.

www.imperial.ac.uk/study/international-students

9 Student Records and Data

The Student Records and Data team are responsible for the administration and maintenance of the student records for all students studying at the College. This includes enrolments, programme transfers, interruption of studies, withdrawals and processing of examination entry for research degree students. The team also use this information to fulfil reporting duties to the Student Loans Company, Transport for London and the UKVI, as well as other external bodies.

The team is currently responsible for the processing of student results and awards on the student record system as well as the production and distribution of academic transcripts and certificates of award.

Student Records and Data produce a variety of standard document requests for both current and previous students including council tax letters, standard statements of attendance and confirmation of degree letters.

Appeal administration also sits within the team, as does the responsibility for confirming qualifications via the Higher Education Degree Datacheck service.

Student records and examinations

+44 (0)20 7594 7268

records@imperial.ac.uk

Degree certificates

+44 (0)20 7594 8037

certificates@imperial.ac.uk

10 Work-life balance

The pace and intensity of postgraduate study at Imperial can be demanding so it's important to find time for outside interests.

Imperial College Union

The Union's range of 340+ student-led clubs, societies and projects is one of the largest of any UK university, opening up lots of ways for you to enjoy your downtime.

www.imperialcollegeunion.org/about-us

Graduate Students' Union

The Graduate Students' Union is the postgraduate arm of Imperial College Union. The GSU works alongside the Imperial College Union President to ensure that the requirements of postgraduate students are catered for. It also organises a number of academic and social events during the year.

www.union.ic.ac.uk/presidents/gsu

Sport

Beginners and semi-professionals alike will receive a warm welcome in our sports clubs, which are subsidised by Imperial College Union to make it a little bit cheaper to keep doing a sport you love.

Access to swimming facilities, including sauna, steam room and spa at Ethos sports centre, is completely free from your very first day. Gym facilities across all campuses are also free after you've completed a fitness orientation for a one-off charge (£40 in 2016–17).

www.imperial.ac.uk/sport

11 Student feedback and representation

Feedback from students

The College and Union is committed to continually improving your education and wider experience and a key part of this is your feedback. Feedback is thoroughly discussed by your student representatives and staff.

Student representation

Student Representatives are recruited from every department to gather feedback from students to discuss with staff. More information about the role, and instructions on how to become an academic representative, are available on the Imperial College Union (ICU) website.

www.imperialcollegeunion.org/your-union/your-representatives/academic-representatives/overview

Staff-Student Committee

The Staff-Student Committee is designed to strengthen understanding and improve the flow of communication between staff and students and, through open dialogue, promote high standards of education and training, in a co-operative and constructive atmosphere. College good practice guidelines for staff-student committees are available here:

www.imperial.ac.uk/about/governance/academic-governance/academic-policy/student-feedback

12 Student surveys

Your feedback is important to your department, the College and Imperial College Union.

Whilst there are a variety of ways to give your feedback on your Imperial experience, the following College-wide surveys give you regular opportunities to make your voice heard:

- PG SOLE lecturer/module Survey
- Student Experience Survey (SES)
- Postgraduate Taught Experience Survey (PTES) – next due to run in spring 2018

The PG SOLE lecturer/module survey runs at the end of the autumn term. This survey is your chance to tell us about the modules you have attended and the lecturers who taught them

For PG SOLE your lecturers will receive their individual numerical results and comments shortly after the survey closes. To make the most of your opportunity to give your feedback, please do not use offensive language or make personal, discriminatory or abusive remarks as these may cause offence and may be removed from the results. Whilst this survey is anonymous, please avoid self-identification by referring to personal or other identifying information in your free text comments.

The Student Experience Survey (SES) is another opportunity to leave your views on your experience. This survey will cover your induction, welfare, pastoral and support services experience.

The Postgraduate Taught Experience Survey (PTES) is the only national survey of Master's level (MSc, MRes, MBA and MPH) students we take part in. This is the only way for us to compare how we are doing against the national average and to make changes that will improve our Master's students' experience in future. PTES covers topics such as motivations for taking the programme, depth of learning, organisation, dissertation and professional development. PTES last ran in spring term 2016 and will run again in spring 2018.

All these surveys are anonymous and the more students that take part the more representative the results so please take a few minutes to give your views.

The Union's "You Said, We Did" campaign shows you some of the changes made as a result of survey feedback:

www.imperialcollegeunion.org/you-said-we-did

If you would like to know more about any of these surveys or see the results from previous surveys, please visit:

www.imperial.ac.uk/students/academic-support/student-surveys/pg-student-surveys

For further information on surveys, please contact the Registry's Surveys Team at:

surveys.registrysupport@imperial.ac.uk

13 And finally

Alumni services

When you graduate you will be part of a lifelong community of over 190,000 alumni, with access to a range of alumni benefits including:

- discounts on further study at the College and at Imperial College Business School
- alumni email service
- networking events
- access to the Library and online resources
- access to the full range of careers support offered to current students for up to three years after you graduate
- access to our Alumni Visitor Centre at the South Kensington Campus, with free Wifi, complimentary drinks, newspapers and magazines, and daytime left luggage facility

Visit the Alumni website to find out more about your new community, including case studies of other alumni and a directory of local alumni groups in countries across the world.

www.imperial.ac.uk/alumni

Opportunities for further study

After you have completed MSc Taxonomy and Biodiversity, you may choose to complete a PhD. Many previous graduates have gone on to complete PhDs in the UK, overseas and at ICL. Former students now work as curators, education and scientific officers, postdoc research fellows, for the BBC natural history unit.

You will also be able to join the exclusive alumni Facebook group page (MSc Taxonomy & Biodiversity / MRes Biosystematics) at: https://www.facebook.com/groups/191387750971872/ where you will find lots of posts on jobs, PhDs, postdocs etc. It's a great way to keep in touch with all the past students.

14 Preliminary daily lecture schedule

Week 1 & 2 Induction Week and Module 1 Field Course@ NHM, Collecting, Identification and The Tree of Life

Date	Time	Duration	Staff	Format	Title/Topic	Location
Monday 3 October	09:45-10:00				Arrival at Staff Entrance, Flett Lecture Theatre, NHM, Exhibition Road	
	10:00	1.5	Course Directors		Introduction to MSc/MRes courses	UBR, (UBR) NHM
	11:30	1			Introduction to computing and network system at NHM	LBR
	14:00	1.5			Issuing of Museum passes in Control Room	NHM
					Discussion of MRes research projects	UBR
	16:15-17:00			Lecture	Welcome from Provost	Great Hall, Sherfield Building, ICL
	17:00	2.5		Social	NHM PG Students Welcome Party	DC2 8 Floor, NHM
Tuesday 4 October	10:00	2		Tour	NHM Library Tours	Meet in UBR
	13:30	0.5		Tour	Introduction to Imperial Facilities	Reception Sir Ernst Chain, ICL
	14:00	4		Social	Freshers' Fair	ICL
	15:30	1		Lecture	Primary Safety Induction	G34 ICL
	16:30	1.5		Social	Welcome Drinks Reception for Dept Life Sciences PG Students	G47A&B, Flowers Building, ICL
Wednesday 5 October	10:00	2		Tour	Tour of Museum	Meet UBR, NHM
	13:00	1		Tour	More Tour of Museum	
	14:00	1	Personal Tutors	Meeting	Introduction to Personal Tutors	Meet at Cocoon Cafe
Thursday 6 October	10:00	1	Anne Jungblut	Lecture	The Three Domains of Life	UBR
	11:00	1	Anne Jungblut	Lecture	Protists: The vast microbial dimensions of eukaryote diversity	UBR
	13:00	2	Ronald Jenner	Lecture	Metazoa I and II	UBR
Friday 7 October	10:00	1.5	Zerina Johanson	Lecture	Vertebrates	UBR
	11:30	1.5	Martin Bidartondo	Lecture	Fungal biodiversity I and II	UBR

	14:00	3	Duncan Sivell, Alberto Zilli & David Ouvrard	Practical	Setting up traps for entomology	NHM Wildlife Garden

Week 2 Module 1 Field Course@ NHM, Collecting, Identification and The Tree of Life

Date	Time	Duration	Staff	Format	Title/Topic	Location
Monday 10 October	10:00	1	Paul Kenrick	Lecture	The Plant Tree of Life	UBR
	11:00	6	Mark Carine, Fred Rumsey, Sven Buerki	Practical	Collecting and identifying botanical specimens Botanical Collections	NHM and ICL Lab RCS1 Chain Lab
Tuesday 11 October	10:00	2	Andrea Waeschenbach	Lecture	The Lophotrochozoa I and II	UBR
	12:00	5	Ben Price, Steve Brooks	Practical	Collecting and identifying freshwater specimens	RCS1 Chain Lab, ICL
Wednesday 12 October	10:00	2	Max Barclay	Lecture	The Insects I and II	UBR
	12:00	5	David Ouvard, Gavin Broad, and colleagues	Practical	Collecting and identifying entomological specimens	RCS1 Chain Lab, ICL
Thursday 13 October	10:00	7	Thomas Creedy	Practical	Measures and measuring of biodiversity: Invertebrate sorting, data preparation, data analyses	RCS1 Chain Lab, ICL
Friday 14 October	10:00	1.5	Juliet Brodie	Lecture	Algae and the Tree of Life	UBR
	11:30	1	Ian Owen	Lecture	Birds	Tbc
	14:00	1	Chris Stringer	Lecture	Human Evolution	UBR

Week 3 Module 3 Biological Computing in R

Date	Time	Duration	Staff	Format	Title/Topic	Location
Monday 17/10/2016	09:00	0.5	Samraat Pawar	Lecture	Why R? Why us? (Group A+B) Intro to R and the week's module, R; vs. other languages	Fisher/ Haldane
	09:30	1.5	Samraat Pawar	Lectures + Exercises	Easing into R (Group A)	Hamilton
	11:00	1.5	Samraat Pawar	Lectures + Exercises	Useful R commands and functions (Group A)	Hamilton
	13:30	1.5	Samraat Pawar	Lectures + Exercises	Easing into R (Gp B)	Hamilton
	15:30	1.5	Samraat Pawar	Lectures + Exercises	Useful R commands and functions (Gp B)	Hamilton
Tuesday 18/10/2016	09:15	1.5	Samraat Pawar	Lectures + Exercises	Programming in R (Gp B) Writing functions, programs, debugging in R	Hamilton
	11:00	1.5	Samraat Pawar	Lectures + Exercises	Programming in R (Gp B) Writing functions, programs, debugging in R	Hamilton
	13:30	1.5	Samraat Pawar	Lectures + Exercises	Programming in R (Gp A) Writing functions, programs, debugging in R	Hamilton
	15:30	1.5	Samraat Pawar	Lectures + Exercises	Programming in R (Gp A) Writing functions, programs, debugging in R	Hamilton
Wednesday 19/10/2016	09:15	1.5	Samraat Pawar	Lectures + Exercises	Numerical R (Gp A) Handling Data and Numerical Analyses in R	Hamilton
	11:00	1.5	Samraat Pawar	Lectures + Exercises	Numerical R (Gp B) Handling Data and Numerical Analyses in R	Hamilton
Thursday 20/10/2016	09:15	1.5	Samraat Pawar	Lectures + Exercises	Efficient R (Gp A) Writing efficient programs in R	Hamilton
	11:00	1.5	Samraat Pawar	Lectures + Exercises	Efficient R (Gp A) Writing efficient programs in R	Hamilton
	14:00	1.5	Samraat Pawar	Lectures + Exercises	Efficient R (Gp B) Writing efficient programs in R	Hamilton
	15:30	1.5	Samraat Pawar	Lectures + Exercises	Efficient R (Gp B) Writing efficient programs in R	Hamilton
Friday 21/10/2016	09:15	1.5	Samraat Pawar	Lectures + Exercises	Graphics in R (Gp B) Graphics in R	Hamilton
	11:00	1.5	Samraat Pawar	Lectures + Exercises	Advanced graphics in R (Gp B) ggplot	Hamilton
	13:30	1.5	Samraat Pawar	Lectures + Exercises	Graphics in R (Gp A) Graphics in R	Hamilton
	15:30	1.5	Samraat Pawar	Lectures + Exercises	Advanced graphics in R (Gp A) ggplot	Hamilton

Week 4 Module 4 Introduction to Statistics in R

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 24/10/2016	09:15	3.0	Julia Schroeder	Lectures and Exercises	Probability theory and distributions (Group A)	Hamilton Computer Room, Silwood
	09:15	3.0	Julia Schroeder	Lectures and Exercises	Probability theory and distributions (Group B)	
Tuesday 25/10/2016	09:15	3.0	Julia Schroeder	Lectures and Exercises	Comparing two samples and correlations (Group A)	
	09:15	3.0	Julia Schroeder	Lectures and Exercises	Comparing two samples and correlations (Group B)	
Thursday 26/10/2016	09:15	3.0	Julia Schroeder	Lectures and Exercises	Linear regression analysis (Group A)	
	09:15	3.0	Julia Schroeder	Lectures and Exercises	Linear regression analysis (Group B)	
Friday 27/10/2016	09:15	3.0	Julia Schroeder	Lectures and Exercises	Multiple linear regression (Group A)	
	09:15	3.0	Julia Schroeder	Lectures and Exercises	Multiple linear regression (Group B)	

Week 5 Module 5 GIS

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 31/10/2016	10:00	1.0	David Orme	Lecture	Introduction to GIS	
	11:00	1.0	David Orme	Lecture	Remote sensing and classification	
	13:00	2.0	David Orme	2 sets of 2 hour Practicals	Supervised and unsupervised classification	Hamilton
Tuesday 01/11/2016	10:00	1.0	David Orme	Lecture	Species distribution models	
	11:00	1.0	David Orme	Lecture	Assessing model accuracy	
	13:00	2.0	David Orme	2 sets of 2 hour Practicals	Species distribution modelling	Hamilton
Wednesday 02/11/2016	10:00	1.0	Maria Dickinson	Lecture	Climate change and species distributions 1	
	11:00	1.0	Maria Dickinson	Lecture	Climate change and species distributions 2	
Thursday 03/11/2016	10:00	1.0	Rob Ewers	Lecture	Essentials of land use change modelling	
	11:00	1.0	Rob Ewers	Lecture	Types of land use change models	
	13:00	2.0	Rob Ewers	2 sets of 2 hour Practicals	Modelling tropical deforestation	Hamilton
Friday 04/11/2016	10:00	1.0	David Orme	Lecture	Spatial modelling	
	13:00	1.0	David Orme	2 sets of 2 hour Practicals	Spatial modelling	Hamilton

Week 6 Module 6 – Genomics and Bioinformatics

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 07/11/2016	10:00	1	Jason Hodgson	Lecture	Introduction to genomics and genomic data	Haldane
	11:30	1	Jason Hodgson	Lecture	How and why genetic structure develops within species, and how to test for it.	Haldane
	13:30	3	Jason Hodgson	Computer Practical	Practical introducing students to sources of genomic data, and how to use them.	Hamilton Computer Room
Tuesday 08/11/2016	10:00	1	Jason Hodgson	Lecture	The effects of demography on the genome and methods for inferring demography from genomic data.	Haldane
	11:30	1	Jason Hodgson	Lecture	The genomic effects of gene flow and migration and methods for inferring migration from genomic data.	Haldane
	13:30	3	Jason Hodgson	Computer Practical	Students will analyze a dataset to assess population structure and test for migration	Hamilton Computer Room
Wednesday 09/11/2016	09:30	1	Jason Hodgson	Lecture	Genomic signals of natural selection and methods for detecting natural selection	Haldane
	11:00	1	Jason Hodgson	Lecture	Genomic methods for understanding ecological and conservation problems.	Haldane
Thursday 10/11/2016	10:00	1	Jason Hodgson	Lecture	Introduction to phylogenomics and phylogenomic techniques	Haldane
	11:30	1	Jason Hodgson	Computer Practical	Students will analyze a data set to identify regions that may have been subject to recent natural selection	Hamilton Computer Room
	14:30	2.5	Jason Hodgson	Computer Practical	Students will construct and date a phylogenetic tree.	Hamilton Computer Room
Friday 11/11/2016	10:30	1	Jason Hodgson	Discussion	In small groups students will be given a research question and tasked with designing an appropriate study.	Haldane
	13:30	2	Jason Hodgson	Discussion	Groups will present their study, and field questions from the audience.	Haldane

Week 7 **Module 13** **Ecology and Global Change**

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 14/11/2016	10:00	1	Colin Prentice	Lecture	Timescales and mechanisms of climate change. Broad scale patterns on drivers of climate change	Fisher
	11:30	1	Colin Prentice	Lecture	Climate, CO2 and plants. Impacts of atmospheric change on plants and global feedback mechanisms	Fisher
	14:00	3	Colin Prentice	Computer Practical	Impacts of future climate change on ecosystems and biodiversity. Exploration of likely scenarios of future conditions based on current mathematical models	Hamilton
Tuesday 15/11/2016	10:00	3	Guy Woodward, Becca Kordas, Eoin O'Gorman	Field and lab practical	Field sampling of mesocosms. Field sampling, retrieval of material and initila lab processing and data analysis	Hamilton Field Lab
	14:00	1	Guy Woodward	Lecture	Global biodiversity loss: causes and consequences. Exploration of the 6th Great Extinction and empirical evidence for and against its existence	Fisher
	15:30	1	Guy Woodward	Lecture	Gene-to-ecosystem impacts of climate change. Exploration of how warming alters the pace of life across all levels of biological organisation, and how understanding the connections between them can improve predictive capacity	Fisher
Wednesday 16/11/2016	09:00	4	Guy Woodward, Becca Kordas, Eoin O'Gorman	Lab and computer practical	Processing of mesocosm samples and data analysis. Lab processing of mesocosm samples and data analysis	Hamilton Field Lab
Thursday 17/11/2016	10:00	1	Clare Gray	Lecture	Local-to-global ecological impacts of agriculture. Impacts of land-use change on a global scale on natural ecosystems and the services they provide to human societies	Fisher
	11:30	1	Clare Gray	Lecture	Local-to-global ecological impacts of agriculture Pt II. Impacts of chemical pollutants and GMOs in agroecosystems and collateral impacts	Fisher
	14:00	1	Alex Dumbrell (Essex)	Lecture	Global change impacts on ecosystem functioning. The role of microbes in driving major global biogeochemical cycles in aquatic and terrestrial ecosystems	Fisher
	15:30	1	Alex Dumbrell (Essex)	Lecture	Global change impacts on ecosystem functioning Pt II. Using molecular tools to open the microbial black box and to	Fisher

					understand how community structure links to ecosystem functioning in systems under stress	
Friday 18/11/2016	10:00	1	Becca Kordas / Eoin O'Gorman	Lectu re	Global change in marine ecosystems. Major drivers of change in the global ocean, including overfishing, ocean acidification and pollutant	Fisher
	11:30	1	Guy Woodward	Lectu re	Synergies and multiple drivers of global change. Interactions among multiple stressors and how they can damp or amplify responses, resulting in "ecological surprises"	Fisher
	14:00	3	Guy Woodward, Becca Kordas, Eoin O'Gorman	Pract ical	Practical presentations. Presentations of findings from practical exercises	Fisher

Week 8 **Module 42** **Phylogenetic Reconstruction**

	Date	Time	Dur	Staff	Format	Title/Topic	Location
	Monday 21/11/2016	10:00	0.75	Ian Kitching	Lecture	General introduction	Seminar Room
	Monday 21/11/2016	11:00	1.0	Mark Carine	Lecture	Introduction to cladistic terms and concepts	Seminar Room
	Monday 21/11/2016	13:00	1.0	Mark Carine	Lecture	Characters, character states and homology	Seminar Room
	Monday 21/11/2016	14:15	1.3	Mark Carine	Lecture	Characters and coding	Seminar Room
	Tuesday 22/11/2016	10.00	0.5	Mark Carine	Practical	Introduction	Seminar Room
Group 1	Tuesday 22/11/2016	10:30	1.0	Ian Kitching	Lecture	Cladogram construction and rooting	Seminar Room
	Tuesday 22/11/2016	11.45	1.0	Ian Kitching	Lecture	Missing values and optimisation	Seminar Room
	Tuesday 22/11/2016	14.00	2.5	Mark Carine	Practical	From observations to analysis	UBR/LBR
Group 2	Tuesday 22/11/2016	10.30	2.5	Mark Carine	Practical	From observations to analysis	UBR/LBR
	Tuesday 22/11/2016	14:00	1.0	Ian Kitching	Lecture	Cladogram construction and rooting	Seminar Room
	Tuesday 22/11/2016	15.15	1.0	Ian Kitching	Lecture	Missing values and optimisation	Seminar Room

	Wednesday					Reading Day	
	Thursday 24/11/2016	10:00	1.0	Ian Kitching	Lecture	CI, RI and character weighting	Seminar Room
	Thursday 24/11/2016	11:15	1.0	Dave Williams	Lecture	Consensus methods and total evidence	Seminar Room
	Thursday 24/11/2016	13:15	1.0	Ian Kitching	Lecture	Tree support statistics	Seminar Room
	Thursday 24/11/2016	14:30	1.5	Dave Williams	Lecture	Alternative optimality criteria	Seminar Room
Group 1	Friday 25/11/2016	10:00		YSF			Flett Lecture Theatre
	Friday 25/11/2016	14:30	2.5	Ian Kitching, Mark Carine	Practical	PAUP 4 (Group 2)*	UBR/LBR
Group 2	Friday 25/11/2016	10:00	2.5	Ian Kitching, Mark Carine	Practical	PAUP 4 (Group 1)*	UBR/LBR
	Friday 25/11/2016	14:30		YSF			Flett Lecture Theatre

* Students split into two groups for some activities.

Week 9 Module 25 Molecular Systematics 1

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 28/11/2016	10:00	1.0	Mark Carine	Lecture	Homology and character concepts in morphological and molecular data. Combining DNA and morphology	UBR
	11:15	1.0	Mark Carine	Lecture	Patterns of variation in sequence data	UBR
	13:00	1.0	Alfried Vogler	Lecture	The problem of paralogy: gene families, repetitive DNA etc	UBR
	14:00	1.0	Alfried Vogler	Lecture	Sequence alignment – theory	UBR
Tuesday 29/11/2016	10:00	2.0	Andrew Briscoe	Lecture	Genomics/Metagenomic/Nest Gen Sequencing	UBR
	12:00	1.5	Alfried Vogler	Lecture	Overview of Tree Building methods	UBR
	14:30	2.5	Peter Foster	Practical	Computing	LBR
Wednesday 30/11/2016	10:00	2.0	Peter Foster	Lecture	Models of evolution and maximum likelihood	UBR
	13:00	1.0	Peter Foster	Seminar	Maximum Likelihood seminar	UBR
	14:00	1.5	Peter Foster	Practical	Bayesian analysis practical	LBR
Thursday 01/12/2016	10:00	1.0	Peter Foster	Lecture	Bayesian analysis	UBR
	11:15	1.0	Peter Foster	Seminar	Advanced topics in models	UBR
	14:00	1.5	Peter Foster	Practical	Bayesian analysis practical	LBR
	16:00	2	Steve Russell and team	Practical	Specimen to Tree: Specimen Preparation – genomic DNA extraction	Darwin Centre 2 6th floor labs
Friday 02/12/2016	10:00	.5	Steve Russell and Alfried Vogler	Lecture	Introduction to practical and assessed coursework	DC2
10:30	10.30	5.5	Steve Russell and team	Practical	Specimen to Tree: Specimen Preparation – genomic DNA extraction, DNA analysis (Bioanalyzer) and agarose gel;	DC2

Week 10 **Module 26** **Molecular Systematics 2**

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 05/12/2016	10:00	7	Steve Russell and team	Practical	Specimen to Tree: pooling DNA for Illumina sequencing; metabarcoding PCR products to Sequencing Facility; Visit Sequencing Facility	DC2
Tuesday 06/12/2016	10:00	1	Alfried Vogler	Lecture	Databases for molecular biology and phylogenetics data mining	UBR
	11:00	6	Thomas Creedy, Hannah Norman, Belen Arias, Mizan Rahman	Practical	Metabarcoding pipeline: assemble OTUs	LBR
Wednesday 07/12/2016	10:00	1	Thomas Creedy, Hannah Norman, Belen Arias, Mizan Rahman	Practical	Demonstration CIPRES server: MrBayes, RAxML, PhyloBayes	LBR
	11:00	6	Thomas Creedy, Hannah Norman, Belen Arias, Mizan Rahman	Practical	Building mitogenome tree	LBR
Thursday 08/12/2016	10:00	5.5	Thomas Creedy, Hannah Norman, Belen Arias, Mizan Rahman	Practical	Metabarcoding analyse own data	LBR
	15:45	1.5	Alfried Vogler	Tutorial	Choosing a model; ML analysis of own data	UBR
Friday 09/12/2016	10:00	7	Thomas Creedy, Hannah Norman, Belen Arias, Mizan Rahman	Practical	Placing the OTUs, testing tree	LBR

Week **Module 27 – Generalised Linear Models**

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 16/01/2017	09:15	3	Julia Schroeder	Lecture and Exercises	Likelihood, deviance, and AIC	Hamilton Computer Room
	13:30	3	Julia Schroeder	Lecture and Exercises	Count data and poisson models	Hamilton Computer Room
Tuesday 17/01/2017	09:15	3	Julia Schroeder	Lecture and Exercises	Proportions and the binomial distribution	Hamilton Computer Room
	13:30	3	Julia Schroeder	Lecture and Exercises	Contrasts in linear models	Hamilton Computer Room
Thursday 19/01/2017	09:15	3	Julia Schroeder	Lecture and Exercises	Quasi-poisson models	Hamilton Computer Room
	13:30	3	Julia Schroeder	Lecture and Exercises	Variance and random effects	Hamilton Computer Room
Friday 20/01/2017	09:15	3	Julia Schroeder	Lecture and Exercises	Fixed and random effects	Hamilton Computer Room
	13:30	3	Julia Schroeder	Lecture and Exercises	Mixed effects modeling	Hamilton Computer Room

Module 28 - Advanced Statistics

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 23/01/2017	10:00	1.0	Samraat Pawar	Lecture	Non-linear models in Ecology and Evolution	Fisher
	11:00	1.0	Samraat Pawar	Lecture	Non-linear least squares fitting methods using R	Hamilton Computer Room
	14:00	3.0	Samraat Pawar	Computer Practical	Non-linear least squares fitting methods using R	Hamilton Computer Room
Tuesday 24/01/2017	10:00	1.0	Cristina Banks-Leite	Lecture	Use of ordination in research	Fisher
	11:00	1.0	Cristina Banks-Leite	Lecture	Ordination methods	Fisher
	14:00	3.0	Cristina Banks-Leite	Computer Practical	Ordination in R	Hamilton Computer Room
Wednesday 25/01/2017	10:00	3.0	Joe Tobias	Workshop	Troubleshooting and question session	Fisher
Thursday 26/01/2017	10:00	1.0	Miguel Matias	Lecture	Multivariate analysis in community ecology	Fisher
	11:00	1.0	Miguel Matias	Lecture	Multivariate methods	Fisher
	14:00	3.0	Miguel Matias	Computer Practical	Multivariate analysis in R	Hamilton Computer Room
Friday 27/01/2017	10:00	1.0	Julia Schroeder	Lecture	Ageing wild populations, and cross-sectional vs longitudinal analyses	Fisher
	11:00	1.0	Julia Schroeder	Lecture	Longitudinal and cross-sectional analysis	Fisher
	14:00	3.0	Julia Schroeder	Computer Practical	Longitudinal and cross-sectional analysis practical	Hamilton Computer Room

Module 33 – Palaeobiology
Fossils in Time

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 30 January 2017	10:00	1	Paul Taylor	Lecture	Introduction to Fossils	Neil Chalmers
	11:30	1	Paul Taylor	Lecture	Introduction to stratigraphy and dating	Neil Chalmers
	13:30	1	Greg Edgecombe	Lecture	Fossils and biogeography	Neil Chalmers
	14:30-16:00	1.5	Xiaoya Ma	Lecture	Exceptional preservation and Cambrian explosion	Neil Chalmers
Tuesday 1 February 2017	10:00	1	Greg Edgecombe	Lecture	Fossils and missing data	Neil Chalmers
	11:30	1	Nadia Santodomingo	Lecture	Fossils in phylogenetic analysis	Neil Chalmers
	13:30	2.5	Nadia Santodomingo	Practical	Fossils in phylogenetic analysis	UBR
Wednesday 01/02/2017	10:30-16:00	5.5	Xiaoya Ma	Practical	Morphology and phylogeny of key fossil groups	UBR
Thursday 02/02/2017	10:30-16:00	5.5	Xiaoya Ma	Practical	Morphology and phylogeny of key fossil groups	UBR
Friday 3 February 2017	10:00	1	Paul Kenrick	Lecture	Fossils and climate change	Neil Chalmers
	11:30	1	Ken Johnson	Lecture	Reefs and their responses to past climate change	Neil Chalmers
	13:30	2.5	Ken Johnson	Practical	Historical ecology	UBR
Mass Extinction						UBR
Monday 6 February 2017	10:00	1	Richard Twitchett	Lecture	Responses to past climate change: why is palaeontology important?	Neil Chalmers
	11:30	1	Richard Twitchett	Lecture	Mass extinctions and deep time biodiversity	Neil Chalmers
	13:30	2.5	Richard Twitchett	Practical	Body size trends through time	UBR
Tuesday 7 February 2017	10:00	1	Adrian Lister (AL)	Lecture	Evolution and speciation in the fossil record: examples from Quaternary Mammals	Neil Chalmers
	11:30	1	AL	Lecture	Responses of mammals to climate change: clues from the Late Quaternary extinction event	Neil Chalmers

	13:30	2	Ian Barnes	Lecture	Molecular palaeontology: what can (and can't) be done with ancient DNA	Neil Chalmers

Module 34 – Genetic Mechanisms of Evolution

Date	Time	Dur	Staff	Format	Title/Topic	Location
Wednesday 8 February 2017	10:00	2	Arkhat Abzhanov	Lecture	Introduction to developmental biology	Niel Chalmers
	13:00	1	Arkhat Abzhanov	Lecture	Ontogeny and Phylogeny	Niel Chalmers
	14:15	45m	Arkhat Abzhanov	Lecture	Developmental Gene Toolkit and Body Plans	Niel Chalmers
Thursday 9 February 2017	10:00	2	Arkhat Abzhanov	Lecture	Gene Duplication and Fate of Developmental Genes	Niel Chalmers
	13:00	1	Arkhat Abzhanov	Lecture	Coding vs Regulatory Evolution	Niel Chalmers
	14:15	45m	Arkhat Abzhanov	Lecture	Developmental changes and Origins of Novelty, Diversity and Constraint	Niel Chalmers
Friday 10 February 2017	10:00	2	Arkhat Abzhanov (MB)	Practical	Morphometric Analysis and Research Proposal Preparation (Group I)	Niel Chalmers
	13:00	1	Arkhat Abzhanov	Lecture	Morphometric Analysis of Ontogeny and Phylogeny	Niel Chalmers
	14:00	2	Arkhat Abzhanov (MB)	Practical	Morphometric Analysis and Research Proposal Preparation (Group II)	Niel Chalmers

Module 41 Natural History Collections

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 13 February 2017	10	15m	Martha Richter (MR)	Lecture	Introduction	
	10:15	45m	MR	Lecture	History of the Natural History Collections	UBR
	11:15	45m	MR	Lecture	The Value of collections today	UBR
	14:15	1	MR/Zoe Hughes	Lecture	How collections work: issues with the physical collections	UBR
	15:30	1	Gill Comerford	Lecture	Prevention and cure: managing risks to collections	UBR
Tuesday 14 February 2017	10:00	2.5	Zoe Hughes (ZH)	Practical	Curation Experience	Various
	13:30	3	ZH	Practical	Curation Experience	Various
Wednesday 15 February 2017	10:00	2.5	Zoe Hughes (ZH)	Practical	Curation Experience	Various
	13:30	3	Zoe Hughes (ZH)	Practical	Curation Experience	Various
Thursday 16 February 2017	10:00	1.5	Pip Brewer (PB)	Seminar	Collections in the 21st Century 1: Data gathering	UBR
	11:30	1	Ian Barnes (IB)	Seminar	Collections in the 21st Century 2: Molecules and tissues	UBR
	12:30	1.5		Practical	Prepare for presentations	
	14:00	2	DN/MR	Practical	Workshop and student presentations: summing up	UBR
Friday 17 February 2017	10:00	1	Vince Smith (VS) Dimitris Koureas (DK)	Lecture	Introduction to Biodiversity Informatics	UBR
	11:00	1	VS	Lecture	Computerised identification	UBR
	13:00	4	VS, DK	Practical	Data mobilisation, release. Introduction to Portal	LBR

Module 24 – Principles of Taxonomy

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 20 February 2017	10:00	1	Sandy Knapp	Lecture	Principles of nomenclature and the codes: the universe of codes	UBR
	11:00	1	Sandy Knapp	Lecture	History of the Codes, including changes at the 2011 ICB	UBR
	12:00	1	Max Barclay	Lecture	The International Code of Zoological Nomenclature – Basic principles governing the scientific names of animals	UBR
	14:00	1	Max Barclay	Lecture	Zoological Nomenclature continued	UBR
Tuesday 21 February 2017	10:00	1	Sandy Knapp	Lecture	Botanical Nomenclature and typification	UBR
	11:00	1	Sandy Knapp	Lecture	Plants, algae, fungi	UBR
	12:00	1	Andy Polaszek	Lecture	The Codes of Nomenclature; Bacteria and Viruses, molecular definitions	UBR
	14:00	1	Sandy Knapp	Lecture	Rates of species descriptions and the current state of alpha-taxonomic work – the future of taxonomy	UBR
Wednesday 22 February 2017	10:00	1	Monika Bohm	Lecture	Red Lists – practical issues	
	11:15	1h15m	Monika Bohm	Practical	Incl. Conservation priority-setting; EDGE	
	13:30	1	Chris Lyal	Lecture	Convention on Biological Diversity	
	14:30	2	Chris Lyal	Lecture	Challenges for taxonomy	

Module 43: Methods in Macroecology and macroevolution

Date	Time	Dur	Staff	Format	Title/Topic	Location
Thursday 23 February 2017	10:00	3	NC	Lecture	What are macroecology and macroevolution?	UBR
	14:00	3	NC	Lecture/ Practical	Macroecological patterns and diversity indices.	LBR
Friday 24 February 2017	10:00	3	Andy Purvis	Lecture	Using Big Data in conservation with the PREDICTS project.	UBR
	14:00	3	Terri Cleary	Lecture/ Practical	Using the palaeobiology database (PBDB) to get data on fossil species.	LBR
Monday 27 February 2017	10:00	3	NC	Lecture/ Practical	The comparative method, dealing with phylogenetic non-independence.	UBR/LBR
	14:00	3	NC	Lecture/ Practical	Macroevolutionary patterns and models of evolution.	UBR/LBR
Tuesday 28 February 2017	10:00	3	NC	Practical	Using museum specimen data in macro-scale analyses.	LBR
	14:00	3	Isabel Fenton	Lecture/ Practical	Macro-scale analyses with microfossils.	UBR/LBR
Wednesday 1 March 2017	10:00	3	NC	Lecture/ Practical	Diversification and adaptive radiation.	UBR/LBR
	14:00	3	NC	Tutorial	Critical thinking: Do you trust your methods?	UBR
Thursday 2 March 2017	10:00	All Day	Richard Twitchett	Practical	Using fossil assemblages to assess the impact of mass extinction events: comparative palaeoecology of Ordovician and Silurian fossil assemblages.	UBR/LBR
Friday 3 March 2017	10:00	All Day	Richard Twitchett	Practical	Using fossil assemblages to assess the impact of mass extinction events: comparative palaeoecology of Ordovician and Silurian fossil assemblages.	UBR/LBR

Module 44 – Species and Speciation

Date	Time	Dur	Staff	Format	Title/Topic	Location
Monday 6 March 2017	10:00	1	John Todd	Lecture	What are species?	UBR
	11:15	1	John Todd	Lecture	Species concepts: pros and cons	UBR
	13:00	1.5	Alfried Vogler	Lecture	Phylogeography and population genetics, DNA barcoding	UBR
Tuesday 7 March 2017	10:00	2	Alfried Vogler	Lecture	Intraspecific variation, gene trees and coalescence	UBR
	13:00	1	Mark Carine	Lecture	Speciation in plants	UBR
	15:00	1.5	Alfried Vogler	Tutorial	Barcoding and phylogeography literature	UBR
Wednesday 8 March 2017				Reading Day		
Thursday 9 March 2017	10:00	1	Tim Barraclough	Lecture	Geographic and ecological patterns of species formation	UBR
	11:00	5	Tim Barraclough	Practical	Delimiting species (GMYC)	LBR
Friday 10 March 2017	10:00	1	Tim Barraclough	Lecture	Speciation in asexuals	UBR
	11:00	4	Tim Barraclough	Practical	Delimiting species (GMYC)	LBR