UNIVERSITY OF CAMBRIDGE

# Programme Specification 2024-25

## NATURAL SCIENCES TRIPOS

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|---|---|
| **Awarding body** | University of Cambridge |
| **Teaching institution** | University of Cambridge |
| **Accreditation details** | British Psychological Society<br>The Geological Society<br>Institute of Physics<br>Institute of Materials, Minerals and Mining<br>Royal Society of Chemistry |
| **Name of final award** | Bachelor of Arts (Honours) (for all students)<br>Master of Natural Sciences (M.Sci) (for students who take Part III of the Tripos) |
| **Programme title** | Natural Sciences Tripos |
| **UCAS code** | BCF0 BA/NS |
| **HECoS code(s)** | 100345 (biological sciences), 100425 (physics), 100417 (chemistry), 100225 (materials science), 100394 (earth sciences) |
| **Relevant QAA benchmark statement(s)** | Biosciences, Chemistry, Earth Sciences, Environmental Sciences and Environmental Studies, Materials, Mathematics, Physics Astronomy and Astrophysics, Psychology |
| **Qualifications framework level** | 6 (Honours) 7 (Master of Natural Sciences) |
| **Date specification produced** | March 2024 |

### Programme Aims of the Natural Sciences Tripos

The programme aims to:

- provide an education of the highest calibre across all sciences in order to produce graduates of the quality sought by industry, the professions, and the public service, and to provide academic teachers and researchers for the future.
- provide a broad introduction to a range of sciences and scientific skills at University level, through having studied at least three experimental science subjects and mathematics to some extent.
- allow students to develop specialised knowledge in one or more subjects, by studying these in depth if they so choose.
- provide an intellectually stimulating environment in which students have the opportunity to develop their skills and enthusiasms to the best of their potential.
- attract outstanding students from all backgrounds.

### Programme Outcomes for the Natural Sciences Tripos

Students who qualify with a B.A. degree, having taken Parts IA, IB and II of the Natural Sciences Tripos, should have:

- had experience of a number of broad areas of science from a choice of options, taken to an advanced level, at which current research can be appreciated in some depth.
- completed courses designed to increase their understanding of the broad applicability of their chosen subject in the wider context of scientific study.
- had experience of independent work, including an introduction to aspects of scientific research

- substantially developed intellectual and professional skills in key areas of science
- substantially developed experimental and data analysis skills through a wide range of experiments in the practical laboratories to illustrate major themes of the lecture courses.
- substantially developed communication and management skills through individual and group activities.

Students who qualify with an M.Sci. degree, having also taken Part III of the Natural Sciences Tripos, should have:

- carried out a substantial independent research project in their chosen field and become well-prepared for a career in academic or industrial research.

**Teaching and Learning Methods**

Each course employs a variety of teaching and learning methods, including lectures, seminars, small-group teaching sessions (supervisions), computer work, practical classes, examples classes, online resources, and field trips; not all may be used in each course.

**Assessment**

The individual courses employ a range of assessment techniques, including unseen written examinations, assessed coursework, experiment write-ups, literature and experimental reports, marked essays, oral examinations and project reports and presentations.

Examiners are appointed separately for each course. In the first and second years of the Tripos (Parts IA and IB) the marks for each course are moderated to ensure a fair and comparable distribution of marks is achieved across each subject.
In both IA and IB students are ranked within each subject taken and are awarded a Class based on their performance across their subject results.

In the third and, where applicable, fourth years of the course (Part II and Part III), examiners award marks and classes based on marking criteria approved by the relevant course organisers and Faculty Board.

**Aims, Outcomes and Assessment of Courses**

Each major course of the Tripos has identified its aims, learning outcomes, teaching and learning methods, assessment, and any prerequisite courses. These are included as Appendix A.

**Support for Students and their Learning**

- individual course handbooks, online learning resources and websites (accessible from the NST website http://www.natsci.tripos.cam.ac.uk):
- University, Departmental and College libraries and computing facilities;
- students are assigned a Director of Studies and a personal Tutor by their College;
- small group tutorials (supervisions) provided by Colleges, often with collaboration of Departments for the smaller and/or more specialised subjects;
- extensive staff contact in practical classes and, where applicable, field courses.

**Criteria for Admission**

It is essential for students to have obtained A Level Mathematics and two other science/mathematics A Levels (or the equivalent). Some subjects require or recommend particular A Level prerequisite.

Typical offers from Colleges would be three A Levels at grade A*A*A.

**Mechanisms for evaluating and improving the quality of student learning support**

Students have termly meetings with their College Tutor and Director of Studies to monitor and review their progress in the Tripos. This is facilitated by reports submitted to the Colleges by the student's supervisors on each course. Supervisors normally meet students on a weekly basis.

Each course in the Natural Sciences Tripos has a course management (or teaching) committee, which regularly reviews the content of that course, student feedback and comments from examiners. Students have representation on these committees, either directly or through dedicated staff-student committees.

All Part II and Part III courses and some Part IB courses have external examiners, who are required to submit a report to the University. This is normally responded to by the appropriate Head of Department, or an appointed deputy. The report and response are scrutinised by the General Board's Education Committee.

The Committee of Management for the Natural Sciences Tripos meets twice termly and has student representation. It is responsible for the strategic direction along with routine matters of administration and assessment for the Tripos. The structure and philosophy of the Tripos, in the light of developments in the scientific world and other external changes that may affect the teaching of scientific subjects, is kept under review by the Committee of Management for the Natural Sciences Tripos. The Committee is informed by, and in turn informs, the Faculty Boards and comparable bodies who contribute to the teaching of Natural Sciences.

All Departments who teach in the Tripos are reviewed by the General Board once every two years.

**Employment and Careers**

The Careers Service maintains links with relevant employers and takes into account employer needs and opinions in the services that it provides for students. The Careers Service also allocates a Careers Adviser to each College, Faculty and Department to act as a point of contact.

**Management of Education Quality and Standards**

The University ensures high quality of teaching and learning in the following ways:

1. Scrutiny of the External Examiners Reports for all teaching programmes.
2. Encouraging student engagement at both the local level, through involvement in Faculty and Departmental Committees, and at a central level by participation in nationally benchmarked surveys
3. Participation in the biennial Education Monitoring and Review Process to explore provision, share good practice and suggest constructive courses of action.
4. Mentoring, appraisal, and peer review of staff, and encouraging staff participation in personal development programmes.

**Structure of the Natural Sciences Tripos**

The Natural Sciences Tripos is the framework within which most of the sciences are taught and examined in Cambridge. It is taught primarily by sixteen Departments and includes a wide range of physical and biological sciences, and the history and philosophy of science.

Departments provide the structure for the Tripos, teaching in lectures, and practical and examples classes; all students are members of a Cambridge College, which provides advice on the direction of studies and, in collaboration with the Departments, small-group teaching (supervisions).

The programme is only offered as a full-time course and normally lasts for three or four years, depending on the specialist subjects chosen. Students have a wide choice of subjects from their matriculation and therefore each student has an individual programme of courses leading to their degree. Further information on the Tripos and the individual courses can be found at http://www.natsci.tripos.cam.ac.uk

The First Year (Part IA)

Students may enter Part IA of the Tripos if they have satisfied the criteria for admission specified for the Tripos and have been admitted to a Cambridge College.

Students take four subjects: three experimental subjects and mathematics taken from the lists below. Director of Studies will offer firm advice on the most appropriate mathematical subject, depending on the student's aspirations and previous knowledge.

| Experimental Subjects | Mathematics |
|---|---|
| **Biology of Cells**<br>**Chemistry**<br>**Earth Sciences**<br>**Evolution & Behaviour**<br>**Introduction to Experimental Psychology: From Brain to Cognition ***<br>**Materials Science**<br>**Physics**<br>**Physiology of Organisms** | **Mathematics**<br>**Mathematical Biology** |

* Introduction to Experimental Psychology: From Brain to Cognition and Chemistry cannot be taken together.

Students are expected to attend, for each of the four subjects taken, three lectures, one supervision and an average of two to four hours of practical work during each week of the eight-week terms. College Directors of Studies give further advice on appropriate levels of extracurricular study.

The Second Year (Part IB)

Students may enter Part IB of the Tripos if they have successfully completed Part IA of the Tripos. Students may transfer from another Tripos, providing they have satisfied the criteria for admission specified for the Natural Sciences Tripos and have approval from their College Director of Studies. Many of the subjects offered at Part IB assume specific knowledge of particular Part IA courses.

Students take three subjects from the list given below. There are some restrictions on subject combinations, although there are well over 100 different combinations taken each year.

| | |
|---|---|
| **Chemistry A** | **Biochemistry and Molecular Biology** |
| **Chemistry B** | **Biology of Disease** |
| **Earth Sciences A** | **Cell and Developmental Biology** |
| **Earth Sciences B** | **Ecology & Conservation** |

| | |
|---|---|
| **Materials Science** | **Evolution & Animal Diversity** |
| **Mathematics** | **Experimental Psychology** |
| **Physics A** | **Mathematical and Computational Biology** |
| **Physics B** | **Neurobiology** |
| **Quantitative Environmental Science** | **Pharmacology** |
| **History and Philosophy of Science** | **Physiology** |
| | **Plant and Microbial Sciences** |

Students are expected to attend, for each of the three subjects taken, three lectures, one supervision and up to six hours of practical work during each week of the eight-week terms. College Directors of Studies give further advice on appropriate levels of extracurricular study.

The Third Year (Part II)

Students may enter Part II of the Tripos if they have successfully completed Part IB of the Tripos. Students may transfer from another Tripos, providing they have satisfied the criteria for admission specified for the Natural Sciences Tripos and have approval from their College Director of Studies. Many of the subjects offered at Part II require specific knowledge of particular Part IB courses; in some cases, there may be a specific requirement to have studied these courses at Part IB. In addition, there are a restricted number of places on some Part II courses and students compete for a place based on agreed departmental selection criteria and collaborative procedures.

Students usually choose to specialise in their third year from the subjects outlined below and therefore study one subject in depth.

| | |
|---|---|
| | **Biochemistry*** |
| **Astrophysics*** | **Genetics** |
| **Chemistry*** | **Pathology** |
| **Earth Sciences*** | **Pharmacology** |
| **Materials Science*** | **Physiology, Development, & Neuroscience** |
| **History and Philosophy of Science*** | **Plant Sciences** |
| **Physics*** | **Psychology** |
| | **Zoology** |

** denotes subjects in which you can continue into a fourth year*

Alternatively, students may opt to take one of two more general courses, choosing two subjects from a wider range of topics. These courses allow students to take a course without a practical element.

| | |
|---|---|
| **Physical Sciences** | **Biological and Biomedical Sciences** |

Successful completion of the third year leads to the award of a B.A. degree.

The Fourth Year (Part III)

Students may enter Part III of the Tripos only if they have successfully completed the corresponding Part II course of the Tripos (other than Systems Biology and Quantitative Climate and Environmental Science which do not have Part II 'feeder' courses and History and Philosophy of Science which accepts students from other Part II courses). Fourth year courses are offered in the following subjects:

| |
|---|
| **Astrophysics** |
| **Biochemistry** |
| **Chemistry** |

**Earth Sciences**
**History and Philosophy of Science**
**Materials Science**
**Physics**
**Systems Biology**
**Quantitative Climate and Environmental Science**

Successful completion of the fourth year leads to the additional award of an M.Sci. degree.

There are specific entry requirements for each Part III subject.

Every effort has been made to ensure the accuracy of the information in this programme specification. At the time of publication, the programme specification has been approved by the relevant Faculty Board (or equivalent). Programme specifications are reviewed annually, however, during the course of the academical year, any approved changes to the programme will be communicated to enrolled students through email notification or publication in the *Reporter*. The relevant faculty or department will endeavour to update the programme specification accordingly, and prior to the start of the next academical year.

Further information about specifications and an archive of programme specifications for all awards of the University is available online at: https://www.camdata.admin.cam.ac.uk/

## Appendix A: Programme Outlines for all courses of the Natural Sciences Tripos

### Part IA Biology of Cells

This course is taught jointly by the Departments of Biochemistry, Genetics, Plant Sciences and Zoology.

**Aims**

1. to introduce the basic concepts of cell biology, including cell structure, macromolecules, biochemistry, genetics, molecular biology, development and cell communication;
2. to illustrate the experimental approaches and technologies which have led to our understanding of cell biology;
3. to provide laboratory classes and online exercises complementary to the lecture topics to enable students to experience directly the experimental nature of the subject;
4. to provide sufficient background to enable students to continue with more specialised courses in Part IB, such as Cell and Developmental Biology, Biochemistry and Molecular Biology or Plant and Microbial Sciences.

**Learning Outcomes**

At the end of the course students should:

1. have acquired an understanding of the major concepts in cell and molecular biology, and the experimental approaches taken to address them;
2. be able to write clear and well-argued descriptions of these topics, based on the course material and textbook articles;
3. be able to design, perform and analyse simple experiments in cell and molecular biology;
4. be able to continue with Part IB courses which have substantial elements of cell and/or molecular biology.

**Teaching and Learning Methods**

These include lectures, supervisions, practical classes and web-based exercises.

**Assessment**

Assessment for this course is through:

- one unseen written examination, based on lecture material (for aims 1, 2 and 4 and learning outcomes 1, 2 and 4);
- one unseen written examination, based on material from the practical classes (for aims 2-4 and learning outcomes 1, 3 and 4).

**Courses of Preparation**

**Highly desirable**: A Level Chemistry.

**Recommended**: Although A Level Biology is not a requirement, students who have not done Biology at A Level may wish to consult an A Level Biology text before they come up.

## Part IA Chemistry

This course is taught by the Department of Chemistry.

**Aims**

1. to provide an introduction to university level chemistry, building on ideas and topics previously studied in typical pre-university courses such as GCE A level;
2. to introduce topics in chemistry which are relevant to the further study of chemistry and other molecular sciences within the Natural Sciences Tripos;
3. to introduce the key ideas and concepts which are used to understand and rationalize chemical structures and reactions, and to show how these are applied;
4. to introduce quantitative theories, such as thermodynamics and kinetics, and show how these are applicable to understanding chemical reactivity;
5. to develop practical skills in both preparative chemistry and in making relevant measurements, and interpreting these experiments in the light of the ideas and theories presented in the course.

**Learning Outcomes**

At the end of the course students should:

1. have an enhanced understanding of the chemical principles introduced in the course;
2. be able to apply these principles to solve problems, make calculations, make predictions and rationalize trends;
3. have enhanced practical skills.

**Teaching and Learning Methods**

These include lectures, supervisions and practical classes.

**Assessment**

Assessment for this course is through:

- one unseen written examination (for aims 1-4 and learning outcomes 1-2);
- continuously assessed practical work (for aim 5 and learning outcome 3).

**Courses of Preparation**

**Essential**: A Level Chemistry or equivalent

## Part IA Earth Sciences

This course is taught by the Department of Earth Sciences.

**Aims**

1. to introduce the geological processes of the Earth and other planets, including those beyond our solar system. The key processes are plate tectonics, climate change, magmatism, atmosphere/ocean processes, metamorphism and rock deformation, the evolution of the biosphere and erosion and sedimentation;
2. to introduce key techniques in the study of the Earth, such as geophysical methods, petrographic study, geological maps and sections, sedimentological and palaeontological analysis, and compilation of regional geological history;
3. to provide practical experience, in the laboratory and in the field, of these techniques and of the main classes of geological materials: minerals, fossils, and sedimentary, igneous and metamorphic rocks;
4. to provide sufficient geological foundation to enable students to continue with more specialised courses in Part IB Earth Sciences A and B.

**Learning Outcomes**

At the end of the course, students should have:

1. acquired a broad understanding of the major systems of the Earth, and of the approaches used to understand them;
2. learnt to identify and diagnose a range of geological materials and to analyse simple geophysical and geological data;
3. developed the skill of writing concise, well-structured and clearly illustrated descriptions and analyses of these topics;
4. practised appropriate transferable skills, particularly problem solving, oral and written communication and teamwork (particularly in an outdoor field setting).

**Teaching and Learning Methods**

The course is taught through lectures, practical classes, supervisions, and field courses, including a one-week residential course.

**Assessment**

Assessment for this course is through:

- one unseen written examination, based on material from all teaching methods (for aims 1-2 and learning outcomes 1-3);
- one unseen practical examination, based mainly on material from practical and field classes (for aim 3 and learning outcomes 2 and 4).

**Courses of Preparation**

**Essential**: No previous subject knowledge is necessary.

## Part IA Evolution & Behaviour

This course is taught jointly by the Departments of Zoology, Plant Sciences, Genetics, Biochemistry and the Department of Archaeology.

**Aims**

1. to introduce students to the major principles of evolutionary theory and current global change. Content ranges from the origins of life, through the evolution of plants and animals, the evolution of behaviour, and changes in the natural world as a result of human action;
2. to prepare students for subsequent biology courses that require an understanding of evolution and behaviour, and human impacts;
3. to show how natural selection ultimately underpins all biological processes and how evolution has generated biological diversity;
4. to outline some major events in evolution, from the origin of life to hominin evolution;
5. to investigate the evolutionary basis of behaviour in animals,
6. to develop practical biological skills.

**Learning Outcomes**

At the end of the course students should:

1. have an enhanced knowledge and appreciation of evolutionary biology, behaviour, ecology and conservation;
2. be able to develop cogent and critical arguments based on the course material;
3. be able to perform, analyse and report on experiments and observations in whole organism biology;
4. be able to integrate related topics from separate parts of the course.

**Teaching and Learning Methods**

These include lectures, supervisions, practical classes and optional field courses.

**Assessment**

Assessment for this course is through:

- one unseen written examination (for aims 1-5 and learning outcomes 1-4);
- submission of records of practical work (for aim 6 and learning outcomes 3 and 4).

**Courses of Preparation**

**Essential**: *None*

**Highly Desirable:** A Level Biology

**Part IA Introduction to Experimental Psychology: From Brain to Cognition**

This course is borrowed from the Psychological and Behavioural Sciences Tripos and is taught by the Department of Psychology.

This course covers core areas of experimental psychology and cognitive neuroscience, including perception, attention and cognitive control, learning and memory, reasoning and decision-making, language and neuropsychology. Lectures and practical classes teach the foundations of psychological science and neuroscientific methods. The course is assessed by submission of lab reports for formative assessment and a written examination.

## Part IA Materials Science

This course is taught by the Department of Materials Science & Metallurgy.

**Aims**

This course provides an introduction to Materials Science, focussing on the ways in which processing determines the structure of materials and how this structure, over various length scales, determines material properties. The course is grounded in fundamental physical science concepts, allied to Physics and Chemistry but also has a strongly applied focus with industrial relevance. It allows students to broaden their scientific horizons beyond the disciplines they have studied at school and particularly appeals to students whose interests are in applied experimental science. It is primarily aimed at those studying other physical science subjects in Part IA of the Tripos and provides a good grounding in solid state science for those who will go on to specialise in Physics, Chemistry or Earth Sciences, or as the basis for the further study of Materials Science.

**Learning Outcomes**

At the end of the Part IA Materials Science course, students will be expected to have:

1. acquired an understanding of the main principles related to the processing, structure and properties of materials and the experimental approaches used to reveal these concepts;
2. developed an understanding of the structures of materials on various length scales;
3. acquired the ability to carry out basic calculations related to the structure, physical properties and chemical stability of materials;
4. learned good experimental practice and be confident in a range of simple laboratory techniques;
5. carried out project work in small groups and written an individual report detailing that work.

**Teaching and Learning methods**

These include lectures, practicals, supervisions and use of dedicated software packages.

**Assessment**

Assessment for this course is through:

- one unseen written examination based on material given in lectures and practicals throughout the year.
- completion of online worksheets related to each practical class, and submission of short lab notes;
- a project report on the deconstruction of an item, and characterisation of its components;
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**Courses of Preparation**

**Essential:** A Level (or equivalent) Physics or Chemistry.
No previous subject knowledge is necessary.

## Part IA Mathematical Biology

This course is taught jointly by several departments in the School of Biology.

**Aims**

1. to introduce students to the application of mathematical modelling in the analysis of biological systems including populations of molecules, cells and organisms;
2. to show how mathematics, statistics and computing can be used in an integrated way to analyse biological systems;
3. to develop students' skills in algebraic manipulation, the calculus of linear and non—linear differential equations, mathematical modelling, linear algebra and statistical methods;
4. to introduce students to scientific programming and data analysis.

**Learning Outcomes**

At the end of the course, students should:

1. have an enhanced knowledge and understanding of mathematical modelling and statistical methods in the analysis of biological systems;
2. be better able to assess biological inferences that rest on mathematical and statistical arguments;
3. be able to analyse data from experiments and draw sound conclusions about the underlying processes using their understanding of mathematics and statistics;
4. understand the use of computers to assist them in using mathematical models and carrying out statistical tests.

**Teaching and Learning Methods**

These include lectures, supervisions, and computer practicals.

**Assessment**

Assessment for this course is through:

- one unseen written examination, based on lecture material (for aims 1-4 and learning outcomes 1-4);
- three assessed exercises, based on the lectures and practicals (for aims 1-4 and learning outcomes 1-4).

Accreditation

Completion of this course contributes towards receiving accreditation from the British Psychological Society, when continuing on to complete NST IB Experimental Psychology and NST Part II Psychology.

**Courses of Preparation**

**Essential**: A Level Mathematics or equivalent, as set out in the NST admissions entry requirements.

## Part IA Mathematics

This course is taught by the Department of Applied Mathematics and Theoretical Physics with input from other Physical Science Departments.

There are two versions of the course, A and B. Course A provides a thorough grounding in methods of mathematical science and contains everything prerequisite for the mathematical content of all physical-science courses in Part IB of the Natural Sciences Tripos, including specifically Mathematics, Physics A and Physics B.
Course B contains additional material for those students who find mathematics rewarding in its own right, and it proceeds at a significantly faster pace. Students are strongly encouraged to take Course A unless they have a thorough understanding of material in Further Mathematics A level. Both courses lead to the same examination and qualification.

**Aims**

1. to provide a course on elementary mathematical techniques that are used in the physical sciences courses of the Natural Sciences Tripos;
2. to prepare students for more advanced mathematical courses in the Natural Sciences Tripos;
3. to develop mathematical skills and methods appropriate for students in the physical sciences. A detailed syllabus is determined by a committee which has input from the physical science subjects in the Natural Sciences Tripos.

**Learning Outcomes**

At the end of the course students should:

1. have a knowledge and understanding of a range of elementary mathematical techniques;
2. be able to solve mathematical problems based on the course material.

**Teaching and Learning Methods**

These include lectures, supervisions, and occasional examples classes.

**Assessment**

Assessment for this course is through:

- two unseen written papers each of three hours (for aims 1-3 and learning outcomes 1-2);

**Courses of Preparation**

**Essential**: A Level Mathematics or equivalent, as set out in the NST admissions entry requirements.

**Recommended**: A Level Further Mathematics

## Part IA Physics

The course is taught by the Department of Physics.

**Aims**

1. to consolidate school physics, providing a more analytical framework for Newtonian statics and dynamics, oscillations and waves, electric circuits, and gravitational and electromagnetic fields, and to introduce new themes, including special relativity and quantum mechanics;
2. to bridge the gap between school and university level physics by encouraging mathematical model building and by broadening the perspective, so that students appreciate the generality of the laws of physics;
3. to develop basic skills in the collecting and analysis of experimental data;
4. to provide a sound foundation for later courses in physics and in other physical sciences.

**Learning Outcomes**

At the end of the course students should:

1. have attained a sound level in basic physics, and laid a secure foundation for NST Part IB Physics A and Physics B, and for other NST Part IB courses;
2. have developed problem-solving skills in basic physics;
3. have developed experimental and data analysis skills through a range of straightforward experiments in the practical laboratories;
4. have developed communication skills in describing physical arguments and reporting the results of experiments.

**Teaching and Learning Methods**

These include lectures, supervisions and practical classes.

**Assessment**

Assessment for this course is through:

- one unseen examination, based on lectures and some practical class material (for aims 1-2, 4 and learning outcomes 1-2);
- continuously assessed practical work (for aims 2-4 and learning outcomes 3-4).

**Courses of Preparation**

**Essential**: A Level Physics and Mathematics, or Mathematics and Further Mathematics (with three units of Mechanics).

**Useful:** AS or A Level Further Mathematics. We also expect students to take the Part IA Mathematics Paper in parallel with Physics.

## Part IA Physiology of Organisms

This course is taught jointly by the Departments of Physiology, Development & Neuroscience, Plant Sciences and Zoology.

**Aims**

1. to provide a course of comparative physiology and neurobiology, introducing students to the principles of normal biological function in a wide range of organisms;
2. to prepare students for subsequent biological courses that require an understanding of physiology and/or neuroscience;
3. to compare how animals and plants maintain an internal steady state, how they acquire and dispose of nutrients and how they detect and respond to changes in their environments;
4. to outline the physiology of bacteria and fungi;
5. to consider the influence that body size has on physiology;
6. to develop practical biological skills.

**Learning Outcomes**

At the end of the course students should:

1. Have an enhanced knowledge and appreciation of the physiology of organisms;
2. Be able to explain the similarities and differences in how animals and plants maintain an internal steady state, how they acquire nutrients and how they detect and respond to changes in their environments;
3. Be able to outline the basic physiology of bacteria and fungi and how they interact with other organisms;
4. Understand the influence that body size has on physiology;
5. Be able to develop cogent and critical written arguments, requiring the integration of related topics from separate parts of the course;
6. Be familiar with the safe use and application of some of the basic laboratory equipment used in physiological studies of plants and animals;
7. Be able to perform, critically analyse and report on experiments and observations in physiology.

**Teaching and Learning Methods**

These include:

- Lectures, practical classes and practical feedback provided in seminar format or through online notes.
- Additional, web-based resources
- College-based supervisions.

**Assessment**

Assessment for this course is through:

- one unseen written examination, covering the theory parts of the course (for aims 1-5 and learning outcomes 1-5);
- one unseen written examination, assessing the practical material (for aim 6 and learning outcomes 6-7).

**Courses of Preparation**

**Essential**: *None.*

| | |
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| **Recommended**: | A2 Level Biology.<br>AS/A2 level Chemistry and/or Physics will also be useful. Although most of our students would not have physics. |

## Part IB Biochemistry & Molecular Biology

This course is taught by the Department of Biochemistry.

**Aims**

1. To build on the Part IA Biology of Cells course, providing an advanced foundation for specialist further study of Biochemistry or other molecular biosciences in:

- the structural organisation of genes and the control of gene expression in prokaryotes and eukaryotes;
- protein structure, enzyme catalysis and protein engineering;
- the control of metabolic pathways, energy transduction and cell growth;
- the methods used to analyse biochemical structures and processes;
- the implementation of experimental protocols, use of laboratory equipment and of software to analyse molecular structure and sequences
- the principles that underlie experimental design

**Learning Outcomes**

At the end of the course students should have knowledge and understanding of:

1. recombinant DNA technology; chromatin structure, gene expression;
2. protein structure and folding, conformational mobility and stability, principles of enzyme kinetics, enzyme mechanisms, allostery and antibody recognition and protein design;
3. structural basis and mechanism of energy transduction in organelles and organisms, and of the control of metabolic flux;
4. the control of eukaryotic cell cycle; the principal mechanisms by which oncogenes and tumour suppressor genes perturb normal cell proliferation;
5. signal transduction across membranes and within and between cells;
6. understanding diversity of the eukaryotic cell;
7. the mechanisms of chemotaxis in bacteria;
8. the analysis and critical interpretation of the results of biochemical experiments using examples from their own laboratory practice, journal clubs and lectures.

**Teaching and Learning Methods**

These include lectures, practical classes and discussions, computer applications, journal clubs, experimental design sessions, online quizzes and materials, and supervisions.

**Assessment**

Assessment for this course is through:

- one unseen written examination based on the content of the lecture courses (for aim 1 and learning outcomes 1-8);
- one unseen written examination based on the content of the lectures (1/3) and the practical work conducted throughout the year (2/3), and drawing on the background given in lectures (for aim 1 and learning outcomes 1-8);
- satisfactory completion of the practical course.

**Courses of Preparation**

**Essential**: NST Part IA Biology of Cells

**Recommended:** Knowledge of A level Chemistry is assumed.

## Part IB Biology of Disease

This course is taught by the Department of Pathology.

**Aims**

1. to describe the mechanisms of disease processes and to convey to the student an understanding of the natural history and dynamic nature of disease processes;
2. to produce a stimulating and challenging learning environment where teaching is informed by research and encourages the student to develop skills of observation, analysis and deduction;
3. to enable students to acquire a knowledge and understanding of the scientific basis of disease, and to progress to the Part II courses in biological sciences.

**Learning outcomes**

At the end of the course, students should be able to:

1. demonstrate a knowledge of the nature of the response to injury;
2. demonstrate a knowledge of innate and adaptive immunity, including the process of inflammation;
3. demonstrate a knowledge of how microbial pathogens (viruses, bacteria, fungi, and parasites) infect and replicate in their hosts, evade immune defences and cause disease;
4. demonstrate a knowledge of how deregulation of cellular growth and differentiation cause disease;
5. demonstrate a knowledge of the pathobiology of the circulation, including the process of thrombosis and infarction.
6. demonstrate a knowledge of interactions between infectious organisms and their hosts, with particular reference to emerging infections;
7. identify and concisely describe basic pathological processes from the study of microscopic tissue structure;
8. recognise and identify a number of common bacterial species that may be associated with human and animal diseases.
9. demonstrate knowledge of experimental techniques diagnose and characterise aspects of the immune system and different pathogens.

**Teaching and Learning Methods**

These include lectures, practical classes, supervisions, and small group teaching.

**Assessment**

Assessment for this course is through:

- one unseen written examination (for aims 1-3 and learning outcomes 1-6);
- one unseen practical examination (for aims 1-3 and learning outcomes 1-9).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: NST Part IA Biology of Cells;
NST Part IA Physiology of Organisms.

## Part IB Cell and Developmental Biology

This course is taught jointly by the Departments of Biochemistry, Genetics, Plant Sciences and Zoology.

**Aims**

1. to introduce some of the major ideas and current experimental approaches in cell and developmental biology;
2. to illustrate how molecular approaches complement classical cell biology in providing details of how cells carry out their basic processes;
3. to consolidate and extend students' knowledge of how cells work, how they interact and how they differentiate;
4. to illustrate the excitement of the rapid advances in cell and developmental biology;
5. to provide a framework for further specialised study of molecular, cellular and developmental biology in Part II courses in biological sciences.

**Learning Outcomes**

At the end of the course students should:

1. have developed knowledge of the major ideas in cell biology and developmental biology;
2. have an understanding of the experimental approaches, and how they are applied to specific problems in cell and developmental biology;
3. be able to carry out and interpret experiments in cell and developmental biology.

**Teaching and Learning Methods**

These include lectures, supervisions and practical work.

**Assessment**

Assessment for this course is through:

- one unseen written examination based on the content of the lecture courses (for aims 1-4 and learning outcomes 1 and 2);
- one unseen examination, based on the content of the lecture courses and on practical work conducted throughout the year (for aims 1-4 and learning outcomes to 3).

**Courses of Preparation**

**Essential**: NST Part IA Biology of Cells

## Part IB Chemistry A

This course is taught by the Department of Chemistry.

**Aims**

1. to build on the knowledge and ideas gained from Part IA Chemistry;
2. to introduce the theories and techniques used to understand and probe the behaviour of individual molecules (i.e. quantum mechanics and spectroscopy), collections of such molecules (i.e. statistical thermodynamics) and the solid state (i.e. free-electron and band theory);
3. to show how these ideas can be applied to understand a wide range of physical and chemical phenomena;
4. to develop practical skills involved in making and interpreting physical measurements in the light of the theories studied in the course;
5. to develop skills in using computer programs to make calculations of molecular properties and to understand the significance of the results in the light of the theories studied in the course.

**Learning Outcomes**

At the end of the course students should:

1. be able to apply the theories and concepts introduced in the course to solve problems, perform calculations, make predictions and rationalize trends;
2. have enhanced practical skills, particularly in the areas of making and interpreting measurements, analysing data and using computer programs to compute molecular properties.

**Teaching and Learning Methods**

These include lectures, supervisions and practical classes and computer-based exercises.

**Assessment**

Assessment for this course is through:

- two unseen written examinations (for aims 1-3 and learning outcome 1);
- continuously assessed practical work, including computer-based exercises (for aims 4-5 and learning outcome 2).

**Courses of Preparation**

| | |
|---|---|
| **Essential**: | NST Part IA Chemistry; *and*<br>NST Part IA Mathematics (preferred) *or* NST Part IA Mathematical Biology. |
| **Recommended**: | NST Part IA Physics;<br>NST Part IA Materials Science. |

## Part IB Chemistry B

This course is taught by the Department of Chemistry.

**Aims**

1. to build on the knowledge and ideas gained from Part IA Chemistry;
2. to introduce the concepts and ideas used to understand the structures and reactions of a wide range of chemical compounds, with particular emphasis on the areas of organic chemistry, electron deficient compounds and transition metal complexes;
3. to understand the importance of the shapes and structures of molecules, and how these properties can be determined i.e. by spectroscopy or diffraction;
4. to introduce the way in which an understanding of chemical concepts is crucial for understanding the molecular basis of living systems;
5. to develop practical skills involved in preparing, purifying and characterising typical organic and inorganic compounds.

**Learning Outcomes**

At the end of the course students should:

1. be able to apply the ideas and concepts introduced in the course to solve problems, make predictions and rationalize trends;
2. have enhanced practical skills, particularly in the area of preparative chemistry.

**Teaching and Learning Methods**

These include lectures, supervisions and practical classes.

**Assessment**

Assessment for this course is through:

- two unseen written examinations (for aims 1-4 and learning outcome 1);
- continuously assessed practical work (for aim 5 and learning outcome 2).

**Courses of Preparation**

**Essential**: NST Part IA Chemistry

**Recommended:** NST Part IA Biology of Cells

## Part IB Earth Sciences A

This course is taught by the Department of Earth Sciences.

**Aims**

1. to investigate the processes - physical, biological, and chemical - that form and deform sedimentary rocks, as well as the geophysical aspects of plate tectonics;
2. to provide practical experience of the description of sedimentary rocks and fossils and their application to resolving climatic, depositional, and burial histories, as well as tectonic analysis;
3. to promote the development of field skills necessary for the independent mapping project to be undertaken by students carrying on to Part II;
4. to explore the regional geology of southwest England in lectures, practicals, and fieldwork.

**Learning Outcomes**

At the end of the course, students should have:

1. developed skills relevant to field work to a level where independent mapping may be undertaken;
2. recognised the links between the atmosphere, hydrosphere, biosphere, and lithosphere and how together they impact the sedimentary and climatic history of Earth;
3. attained a reasonable working knowledge of the geology of the southwest of England;
4. progressed from the more guided learning of NST Part IA Earth Sciences to the independent learning required of students carrying on to Part II Earth Sciences.

**Teaching and Learning Methods**

The course is taught through lectures, practical classes, supervisions, and field courses, including ten days in southwest England and nine days in Cumbria.

**Assessment**

Assessment for this course is through:

- two unseen written examinations, based on material from all teaching methods (for aims 1 and 4 and learning outcomes 1, 3 and 4);
- two unseen practical examinations, based mainly on material from practical and field classes (for aims 2-4 and learning outcome 1).

**Courses of Preparation**

**Essential**: NST Part IA Earth Sciences.

## Part IB Earth Sciences B

This course is taught by the Department of Earth Sciences.

**Aims**

1. to gain an understanding of the geophysical and geochemical processes in the Earth's interior, the evolution of the solar system, plate tectonics, mineral behaviour, melting, crystallisation and the deformation of rocks from igneous and metamorphic terrains;
2. to introduce and build on key techniques in the study of the Earth's interior, such as optical mineralogy, petrography, mineral and rock phase equilibria, thermodynamics, structural analysis, and application of these to deciphering regional geological evolution of selected regions;
3. to provide practical experience, in the laboratory and in the field, of these techniques and of the variety of materials making up the Earth's crust and mantle;
4. to gain a strong foundation in the subject and to enable students to continue with more specialised courses in Part II.

**Learning Outcomes**

At the end of the course, students should have:

1. acquired a broad understanding of the igneous, metamorphic, deformational and mineral-forming processes affecting the Earth and its materials, and of the approaches used to understand them;
2. learnt to identify and diagnose a range of minerals, rocks and their textures and structures, and to analyse regional geological data;
3. developed the skill of writing concise, well-structured and clearly illustrated descriptions, and analysing problems related to these topics;
4. acquired appropriate transferable skills, particularly problem solving, oral and written communication and teamwork (particularly in an outdoor field setting).

**Teaching and Learning Methods**

The course is taught through lectures, practical classes, supervisions, and residential field courses.

**Assessment**

Assessment for this course is through:

- two unseen written examinations, based on material from all teaching methods (for aims 1, 4 and learning outcomes 1, 3 and 4);
- two unseen practical examinations, based mainly on material from practical and field classes (for aims 2-4 and learning outcome 1).

**Courses of Preparation**

**Essential**: NST Part IA Earth Sciences.

## Part IB Ecology & Conservation

This course is taught jointly by the Departments of Plant Sciences and Zoology.

**Aims**

1. to develop key ecological concepts and approaches;
2. to introduce major ecosystems;
3. to offer information and literature references to enable students to develop and defend a reasoned position on current issues in ecology and conservation;
4. to introduce habitats, organisms, approaches and the methodology of ecological research on the field course and through project work.

**Learning Outcomes**

At the end of the course, students should be able to:

1. describe the main ecosystems on Earth and interpret their distributions;
2. explain how ecosystems are structured, and how they function, using clearly defined scientific terminology;
3. define the main ecological and evolutionary processes, including succession, dispersal, speciation, extinction and drift, and explain how these processes operate to structure ecosystems;
4. construct rational, evidence-based arguments to address controversial issues about the interaction between humans and the environment, such as large-scale biodiversity loss, invasive species and climate change;
5. design and carry out hypothesis-driven ecological research, including statistical analysis using R;
6. present ecological findings and arguments to colleagues, in an engaging and effective manner.

**Teaching and Learning Methods**

These include lectures, supervisions, field excursions, workshops, an optional field course and presentations of project results.

**Assessment**

Assessment for this course is through:

- two unseen written examinations (for aims 1-3 and learning outcomes 1 - 4);
- one report on independent project work carried out either on the field course or during the academic year (for aims 1, 3 and 4 and learning outcomes 5 and 6).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: NST Part IA Evolution & Behaviour;
NST Part IA Physiology of Organisms;
A Level Biology.

## Part IB Evolution & Animal Diversity

This course is taught by the Departments of Zoology and Genetics.

**Aims**

1. to show how the form, function and behaviour of animals become adapted to the environment through evolution;
2. to elucidate general biological principles through the study of specialised or experimentally tractable systems;
3. to prepare students for Part II courses that require knowledge of animal biology at the systems and organismal levels;
4. to develop students' practical scientific skills.

**Learning Outcomes**

At the end of the course, students should be.

1. able to appreciate the complexities of biological organisation and address scientifically controversial issues in a rational way;
2. able to interpret material in terms of biological function and the effect of natural selection;
3. able to analyse and report on material learned;
4. able to assess the scope of animal biology and select particular areas for further study;
5. aware of the breadth of studies on the biology of animals as they relate to the evolution, function, behaviour and ecology of animals;
6. able to integrate related topics from separate parts of the course.

**Teaching and Learning Methods**

These include lectures, supervisions and practical classes.

**Assessment**

Assessment for this course is through.

- two unseen written examinations, based on lecture material (for aims 1-3 and learning outcomes 1-6);
- continuous assessment of practical work (for aims 1-4 and learning outcomes 1-6).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: NST Part IA Evolution & Behaviour (particularly helpful);
NST Part IA Biology of Cells (helpful);
NST Part IA Physiology of Organisms (helpful).

## Part IB Experimental Psychology

This course is taught by the Department of Psychology.

**Aims**

1. to introduce students to a broad range of the key topics in experimental psychology and to provide the opportunity to learn about experimental procedures in experimental psychology through practical classes;
2. to prepare students for the Part II Psychology course.

**Learning Outcomes**

At the end of the course, students should possess:

1. skills of arguing towards theoretical conclusions about mental processes from empirical evidence and a knowledge base from which to argue;
2. an appreciation of the principles of behavioural experimentation, acquired through participation in practical classes (and from videos and films);
3. skills of scientific reporting, developed through writing practical reports;
4. a thorough understanding of experimental methodology, design and statistical analysis.

**Teaching and Learning Methods**

These include lectures, practical classes and supervisions.

**Assessment**

Assessment for this course is through:

- two unseen three-hour written examinations, (for aims 1 and 2 and learning outcomes 1, 2 and 4);
- submission of five practical reports of work conducted in practical classes (for aims 1 and 2 and learning outcome 3).

Accreditation

Completion of this course contributes towards receiving accreditation from the British Psychological Society, when continuing on to complete NST Part II Psychology Option A (NST Part II Psychology Option B does not qualify a student for accreditation). Students are also required to have completed NST IA Mathematical Biology.

**Courses of Preparation**

**Essential**: *None*

**Recommended**: *None*

## Part IB History and Philosophy of Science

This course is taught by the Department of History and Philosophy of Science.

**Aims**

1. to give students an insight into the historical foundations of modern science and medicine within Western society, and into their philosophical structure and presuppositions;
2. to encourage critical and analytical thought;
3. to help students develop a broader understanding and appreciation of their scientific work;
4. to develop skills in written communication.

**Learning Outcomes**

At the end of the course students should:

1. have an understanding of major themes in the development of science and medicine;
2. have a more critical appreciation of the place of science and medicine in contemporary society;
3. be able to draw together different parts of the course material;
4. have an introductory knowledge of historical, philosophical and sociological methods for analysing science and medicine;
5. have improved their writing skills.

**Teaching and Learning Methods**

These include lectures, supervisions and assigned reading.

**Assessment**

Assessment for this course is through:

- two unseen written examinations (for aims 1-4 and learning outcomes 1-5).

**Courses of Preparation**

**Essential**: *None.*

## Part IB Materials Science

This course is taught by the Department of Materials Science & Metallurgy.

**Aims**

This course builds on Part IA Materials Science, adding further depth of knowledge and understanding across a range of materials classes. There is a broader coverage of applied aspects such as materials fabrication and usage. The project activities aim to develop skills allied to real world Materials Science issues. The course is valuable for those studying other experimental physical science subjects as well as providing the key framework for those intending to specialise in Materials Science in Part II.

**Learning Outcomes**

At the end of the Part IB Materials Science course students will be expected to have:

1. acquired broad knowledge of the major types of materials and how their properties can be experimentally determined or theoretically modelled;
2. developed a knowledge of fabrication methods and be able to assess the reasons why particular materials and methods of production are chosen in order to achieve a desired set of properties;
3. developed skills in the areas of quantitative analysis, scientific reasoning and written communication;
4. developed practical skills in laboratory work and the necessary associated awareness of health and safety in the laboratory.

**Teaching and Learning Methods**

These include lectures, supervisions, practical classes, microscopy exercises, and a series of project tasks related to key skills in Materials Science.

**Assessment**

Assessment for this course is through:

- two unseen written examinations based on materials given in lectures and practicals throughout the year;
- completion of online worksheets related to each practical class, and submission of short lab notes;
- a series of microscopy exercises;
- a series of project tasks.

**Courses of Preparation**

**Essential**: NST Part IA Materials Science.

## Part IB Mathematical and Computational Biology

The Mathematical and Computational Biology course is taught by the Departments of Genetics, PDN, Pathology, Zoology, Plant Sciences, Veterinary Medicine, Bioinformatics, and Psychology.

**Aims**

Students will develop a strong background in modelling, statistics, fitting models to data, algorithms, simulation, bioinformatics, "big data" and computer programming. The M&CB Course will equip students with a comprehensive suite of quantitative and computational skills that will be useful at Part II, Part III and beyond.

**Learning Outcomes**

At the end of the course students should:

1. have knowledge and understanding of a range of advanced mathematical techniques and their application to biological systems;
2. have an understanding of the fundamental concepts behind some mathematical techniques which can be used to understand biological systems.

Students should also:

1. be able to implement and use common bioinformatics algorithms;
2. be able to develop and analyse mathematical models;
3. be able to use computer and numerical methods related to the course material;
4. be able to develop their own computer programs in Python

**Teaching and Learning Methods**

These include traditional lectures, computational lectures, supervisions, and practical classes.

**Assessment**

Assessment for this course is through:

- one unseen written paper based on the theory components of the course;
- one unseen computational examination focusing on implementation/ practical use of the computational methods and techniques;
- write up of an introductory mini project carried out in Michaelmas Term.
- write ups of two mini projects in the Lent Term.

**Courses of Preparation**

**Essential**: Either IA Mathematics or the IA Mathematical Biology

**Recommended**: A mark of at least 60 is strongly recommended in either IA Mathematics or IA Mathematical Biology.

## Part IB Mathematics

This course is taught by the Department of Applied Mathematics and Theoretical Physics.

In order to take this course, it is highly desirable to have obtained at least a second class (upper or lower division) in NST Part IA Mathematics for Natural Sciences, course A or B. The material from course A is assumed.

**Aims**

1. to provide a course on advanced mathematical and computational techniques that are used in the physical sciences courses of the Natural Sciences Tripos;
2. to develop mathematical skills and methods appropriate for students in the physical sciences. A detailed syllabus is determined by a committee which has input from the physical science subjects in the Natural Sciences Tripos.

**Learning Outcomes**

At the end of the course students should:

3. have a knowledge and understanding of a range of more advanced mathematical techniques;
4. be able to solve mathematical problems based on the course material;
5. be able to use several computer and numerical methods related to the course material.

**Teaching and Learning Methods**

These include lectures, supervisions, practical work on a computer and occasional examples classes.

**Assessment**

Assessment for this course is through:

- two unseen written papers each of three hours (for aims 1 and 2 and learning outcomes 1 and 2);
- six assessed computer practical exercises (for aims 1 and 2 and learning outcome 3).

**Courses of Preparation**

**Essential**: NST Part IA Mathematics, course A or B; *or*
Part IA of the Mathematical Tripos

**Recommended**: NST Part IA Physics

## Part IB Neurobiology

This course is taught jointly by the Departments of Psychology; Physiology, Development and Neuroscience and Zoology.

**Aims**

1. to provide a broad introduction to the nervous system;
2. to introduce students to the scientific concepts underlying the study of neural phenomena;
3. to provide an understanding of the principles underlying cellular, molecular, developmental, sensory, motor and cognitive neurobiology;
4. to prepare students for those Part II courses that contain substantial components of neuroscience.

**Learning Outcomes**

At the end of the course students should:

1. have an enhanced knowledge and appreciation of neurobiology, appropriate for a future career in biology or for advanced study at Part II level;
2. be familiar with a wide range of experimental techniques in neurobiology;
3. be able to develop cogent and critical arguments based on the course material;
4. be able to integrate related topics in cellular, molecular, developmental, sensory, motor and cognitive neurobiology.

**Teaching and Learning Methods**

These include lectures, practical classes and supervisions.

**Assessment**

Assessment for this course is through:

- two unseen written examinations, based on the content of the lecture course (for aims 1-4 and learning outcomes 1-4);
- a practical examination, based on practical work conducted throughout the year (for aim 2 and learning outcome 2).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: The course, including the psychological aspects, is taught from a biological perspective. Biological subjects from NST Part IA, particularly Physiology of Organisms are recommended.

## Part IB Pharmacology

This course is taught by the Department of Pharmacology.

**Aims**

1. to offer a course of lectures in the qualitative aspects of Pharmacology;
2. to offer practical and virtual exercises in the quantitative aspects of Pharmacology;
3. to assess student progress and attainment by formal examinations and drug review video presentation.

**Learning Outcomes**

At the end of the course, students should be able to:

1. explain the principles of ligand-receptor interaction, local and intracellular messengers and integration of signalling pathways;
2. identify the major classes of drug receptors and sites of drug action within the body;
3. identify typical examples of drugs which are used to restore physiological functions in the cardiovascular, renal, respiratory, digestive, peripheral nervous and central nervous systems;
4. demonstrate an understanding of the use of drugs to control inflammation and immune responses or to kill bacteria, viruses or malignant cells;
5. apply the basic principles that govern the absorption, distribution and elimination of drugs to predict the time course of drug concentrations in the body and consider the implications of these principles for the therapeutic use of drugs;
6. recognize the fundamental methods used in pharmacological research and be able to use basic pieces of research equipment.

**Teaching and Learning Methods**

These include lectures, practical classes, and seminars.

**Assessment**

Assessment for this course is through:

- one unseen written examination (for aim 1 and learning outcomes 1-5);
- one unseen written practical examination (for aim 2 and learning outcomes 1, 5 and 6);presentation of a 3 minutes video with data gathered during a drug review project (for aim 3 and learning outcomes 1-6).

**Courses of Preparation**

| | |
|---|---|
| **Essential**: | A Level Biology and/or Chemistry |
| **Recommended**: | Part IA of the NST, including any of Biology of Cells, Chemistry *or* Physiology of Organisms,. |

## Part IB Physics A

This course is taught by the Department of Physics. It is suitable for combination with a wide range of other physical science subjects in the second year. When combined with NST Part IB Physics B, it can lead to NST Part II/III Physics and to Part II Physical Sciences Half-Subject Physics.

**Aims**

1. to provide a continuing education in concepts in physics, which when combined with other courses will provide an illuminating survey of the natural sciences;
2. in combination with Physics B, to establish the first part of the core understanding of physics at a professional level;
3. to introduce new themes including the theory of waves & optics, quantum theory, condensed matter, and the analysis of experimental data;
4. to continue to develop experimental skills and to gain experience of using modern instruments and experimental techniques;
5. to provide a rigorous basis for experimental and theoretical physics at Part II level.

**Learning Outcomes**

At the end of the course students should:

1. have learnt to use powerful tools for tackling a wide range of topics, including oscillations, waves &optics, quantum mechanics and condensed matter physics;
2. further developed their experimental skills through a series of whole-day experiments, which also illustrate major themes of the lecture courses;
3. developed their understanding of experimental methods;
4. have substantially developed problem-solving skills in physics;
5. have further developed communication skills in describing physical arguments and reporting the results of experiments.

**Teaching and Learning Methods**

These include lectures, supervisions, practical classes and research skills training. For those not taking NST Part IB Mathematics, a separate lecture course in Mathematical Methods is offered in the Michaelmas Term. This covers all the mathematics necessary for the core courses in Part II Physics.

**Assessment**

Assessment for this course is through:

- two unseen examinations, based on lectures and some practical class material (for aims 1-3 and 5 and learning outcomes 1 and 3-5);
- continuously assessed practical work and research skills (for aims 4-5 and learning outcomes 2-3 and 4).

**Courses of Preparation**

**Essential**: IA Physics and Mathematics

## Part IB Physics B

This course is taught by the Department of Physics. It is suitable for combination with a wide range of other physical science subjects in the second year. When combined with NST Part IB Physics A, it can lead to NST Part II/III Physics and to Part II Physical Sciences Half-Subject Physics.

**Aims**

1. to provide a continuing education in concepts in physics, which when combined with other courses will provide an illuminating survey of the natural sciences;
2. in combination with Physics A, to establish the first part of the core understanding of physics at a professional level;
3. to introduce new themes including more advanced classical and continuum mechanics, the general development of electromagnetism, and thermodynamics & statistical physics;
4. to continue to develop experimental skills and to gain experience of using modern instruments and experimental techniques;
5. to provide an introduction to scientific computation, using Python; and
6. to provide a rigorous basis for experimental and theoretical physics at Part II level.

**Learning Outcomes**

At the end of the course students should:

1. have learnt to use powerful tools for tackling a wide range of topics, including formal methods in electromagnetism, classical dynamics and thermodynamics;
2. further developed their experimental skills through a series of whole-day experiments, which also illustrate major themes of the lecture courses;
3. developed a basic ability to program in Python;
4. have substantially developed problem-solving skills in physics;
5. have further developed communication skills in describing physical arguments and reporting the results of experiments.

**Teaching and Learning Methods**

These include lectures, supervisions practical and computing classes, and research skills training. For those not taking NST Part IB Mathematics, a separate lecture course in Mathematical Methods is offered in the Michaelmas Term. This covers all the mathematics necessary for the core courses in Part II Physics.

**Assessment**

Assessment for this course is through:

- two unseen examinations, based on lectures and some practical class material (for aims 1-3 and 6 and learning outcomes 1 and 4 -5);
- continuously assessed practical, research skills and computing work (for aims 4-6, and learning outcomes 2-3 and 5).

**Courses of Preparation**

**Essential**: IA Physics and Mathematics

## Part IB Physiology

This course is taught by the Department of Physiology, Development & Neuroscience.

**Aims**

1. to provide a course of study in mammalian, principally human, systems physiology, building on knowledge of basic physiological principles established in the Part IA Physiology of Organisms course;
2. to expand on some areas touched on in 1A Physiology of Organisms and to introduce new and more complex physiological functions;
3. to develop further practical biological skills introduced in 1A Physiology of Organisms;
4. to prepare students for a number of Part II Natural Science courses, principally Physiology, Development & Neuroscience, but also Pharmacology, Pathology and Zoology, among others.

**Learning Outcomes**

At the end of the course students should:

1. have an enhanced knowledge and appreciation of mammalian physiology;
2. understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems;
3. understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail;
4. be able to perform, analyse and report on experiments and observations in physiology;
5. be able to recognise and identify principal tissue structures;

**Teaching and Learning Methods**

These include lectures, supervisions, practical classes and extension sessions.

**Assessment**

Assessment for this course is through two unseen written examinations based on:

- the content of the lecture course (for aims 1-2 and learning outcomes 1-3);
- practical work conducted throughout the year including the interpretation and identification of images taken from slides, micrographs and experimental records (for aims 1 & 3 and learning outcomes 4-5);
- quantitative aspects covered in the lecture course and practical classes (for aims 1-3, and learning outcomes 2, 3 & 4).

**Courses of Preparation**

**Essential**: None.

**Recommended**: Physiology of Organisms, Biology of Cells, A Levels in Biology, Chemistry and/or Physics.

## Part IB Plant and Microbial Sciences

This course is taught by the Department of Plant Sciences.

**Aims**

1. to extend the interest and knowledge of modern plant and microbial science acquired during Part IA courses;
2. to consider fundamental physiological processes such as photosynthesis, water relations and nutrient uptake; the interaction of plants with micro-organisms and animals; plant development; conservation; exploitation of plants and plant products;
3. for each topic, to deal with the major issues and ideas that have arisen both from studying plants and microbes in the field, and to describe current understanding of the relevant processes at the cellular and molecular levels;
4. to provide experience of practical experiments that stimulate, educate and illustrate experimental approaches to plant and microbial sciences, both in the laboratory and in the field, and in local industrial settings;
5. to provide the opportunity to compose and present individual discussions of specific topics in oral presentations;
6. to provide a framework for further study of plant and microbial sciences in Part II courses.

**Learning Outcomes**

At the end of the course students should:

1. have developed a sound knowledge of key concepts and current experimental approaches in plant and microbial sciences;
2. be able to provide reasoned arguments both for and against current hypotheses in plant and microbial sciences;
3. be able to assimilate and provide critical analysis of review articles in plant and microbial sciences;
4. be able to design, perform and interpret experiments to analyse fundamental aspects of plant sciences.

**Teaching and Learning Methods**

These include lectures, supervisions, practical classes including integrated class research projects and a vacation field trip.

**Assessment**

Assessment for this course is through:

- two unseen written examinations, based on the content of the lecture courses and practical work conducted throughout the year (for aims 1-6 and learning outcomes 1-4);
- practicals are also assessed by marks given for practical write-ups (for aims 1-6 and learning outcomes 1-4).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: One or more of the following NST Part IA courses: Biology of Cells, Physiology of Organisms, Evolution and Behaviour.

## Part IB Quantitative Environmental Science

This course is taught jointly by DAMPT, the Departments of Earth Sciences and Chemistry, with guest lectures from the British Antarctic Survey. It is administered through DAMTP.

**Aims**

1. To teach a cross disciplinary course on the use of mathematics in environmental studies and in solving environmental challenges.
2. To engender an understanding of the role that natural scientists (in particular) will play in designing solutions to environmental challenges (air pollution, groundwater pollution, climate change) that students will face over the course of their lifetimes.
3. To learn to apply the maths that students have been taught to environmental problems and how to write simple code to understand what data is telling us and to build a simple climate model.
4. To build an understanding of how Earth's surface environment functions, where energy comes from, where there are environmental challenges and what the nature of the solutions to these environmental challenges might be.
5. To understand how policy makers can benefit from the outcomes of environmental models and where and how science can inform policy.

**Learning Outcomes**

At the end of the course students should:

1. Understand how knowledge of physics, chemistry and biology informs models of environmental systems
2. Be able to write code in python to build simple environmentally relevant models (e.g. a box model for carbon, or a flow model for groundwater)
3. Be able to work with large environmental datasets (e.g. data incorporation, visualisation, regression)
4. Understand how to disseminate scientific concepts to a general audience (e.g. policy makers or the public)

**Teaching and Learning Methods**

Lectures (3x per week), supervisions, and practicals. The practicals are done in the students own time, but with drop-in sessions with demonstrators available during the week.

**Assessment**

Assessment for this course is through:

- one unseen written examination (for aims 1-5 and learning outcomes 1 and 4);
- one unseen computational exam (for aims 1, 3 and learning outcome 2, 3);
- one lab report base on the practical component (for aims 1-4 and learning outcomes 1-3)
- one policy paper (for aims 2, 3, 5 and learning outcome 4)

**Courses of Preparation**

**Essential:** A level mathematics.

**Recommended:** A level further mathematics

## Part II Astrophysics

This course is taught by the Institute of Astronomy.

**Aims**

1. to encourage work of the highest quality in astrophysics and maintain Cambridge's position as one of the world's leading centres in the field;
2. to continue to attract outstanding students from all backgrounds;
3. to provide an intellectually stimulating environment in which students have the opportunity to develop their skills and enthusiasms to the best of their potential;
4. to maintain the highest academic standards in undergraduate and graduate teaching and to develop new areas of teaching and research in response to the advance of scholarship.

**Learning Outcomes**

At the end of the course, students should have:

1. obtained an introduction from the course as a whole to astrophysics, emphasising the very wide range of applicability of concepts from many areas in physics;
2. obtained experience of independent investigation, either through reading for and preparing an essay or through completion of a computational project;
3. developed their appreciation of general reasoning in the physical sciences;
4. developed transferable skills.

**Teaching and Learning Methods**

These include lectures, supervisions, and guidance in producing essays and computational projects.

**Assessment**

Assessment for this course is through:

- four unseen written examinations (for aims 1-4 and learning outcomes 1, 3 and 4);
- either a dissertation of not more than 5000 words, based on a literature survey (for aims 1-4 and learning outcomes 1-4);
- or computational projects (for aims 1-4 and learning outcomes 2-4).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: Part IB Physics A, Physics B and Mathematics

## Part II Biochemistry

This course is taught by the Department of Biochemistry.

**Aims**

1. to provide an advanced understanding of the principles and topics of biochemistry and their experimental basis;
2. to provide training in research skills through an eight-week research project, together with journal clubs and data handling exercises;
3. to provide analytical, oral and written presentational skills.

**Learning Outcomes**

At the end of the course students should be able to:

1. demonstrate advanced knowledge and understanding in a number of core areas;
2. demonstrate knowledge of the objective, methods, results and conclusions of their research project;
3. demonstrate knowledge of the written presentation of research through the production of a report on their research project;
4. analyse critically research literature on contemporary biochemical topics, and present such analyses in both written and oral formats;
5. adopt a problem-solving approach to experimental data;
6. explain the importance and impact of scientific topics to the non-specialist.

**Teaching and Learning Methods**

These include lectures, supervisions, journal clubs with guided detailed analysis of a research paper, classes in data handling and scientific writing, a problem-based learning exercise in bioinformatics, research work, small group teaching with occasions for oral presentations and debate of contemporary biochemical topics and issues of science that affect society.

**Assessment**

Assessment for this course is through:

- four unseen essay examination papers (for aims 1-3 and learning outcomes 1 and 4);
- one data handling examination paper (for aims 1-3 and learning outcomes 1, 4 and 5);
- a dissertation of no more than 5000 words, based on a research project undertaken over an eight-week period (for aims 2 and 3 and learning outcomes 2-5);
- a critical essay of no more than 3000 words (for aims 1 and 3 and learning outcomes 1, 4 and 6).

**Courses of Preparation**

| | |
|---|---|
| Essential: | Part IB Biochemistry and Molecular Biology *or* NST Part IB Cell and Developmental Biology; |
| Recommended: | Knowledge of A Level Chemistry is assumed. |

## Part II Chemistry

This course is taught by the Department of Chemistry.

**Aims**

1. to build on the knowledge and ideas gained from the Part IB Chemistry courses;
2. to further develop the theories and ideas studied previously, extending their scope, the complexity of the systems being studied and the need for critical evaluation;
3. to provide the opportunity for students to deepen their knowledge in particular areas of chemistry up to the level expected for a chemistry graduate;
4. to exemplify and offer the chance to study areas of chemistry which are of current research interest;
5. to build on and develop the practical skills gained in Part IB, introducing more sophisticated measurements and preparative techniques, and the design of experiments;
6. to gain an appreciation of the chemical literature and related data bases and how such information can be accessed and assessed;
7. (optional) to have the opportunity to study a language (Chinese, French, German, Japanese or Spanish); to gain skills in computer programming; to enhance skills in mathematical methods

**Learning Outcomes**

At the end of the course students should:

1. be able to apply the ideas and concepts introduced in the course to solve problems, make calculations, make predictions and rationalize trends;
2. have a deeper appreciation of selected areas of chemistry such as would prepare them for advanced study;
3. have enhanced practical skills;
4. have an appreciation of how to find out and assess chemical information;
5. (optional) have a working knowledge of a foreign language, computer programming or to have gained additional skills in mathematical methods

**Teaching and Learning Methods**

These include lectures, supervisions, practical classes and examples classes.

**Assessment**

Assessment for this course is through:

- four unseen written examinations (for aims 1-4 and learning outcomes 1-2);
- continuously assessed practical work (for aim 5 and learning outcome 3);
- short tests and/or the submission of other exercises (for aims 6-7 and learning outcomes 4-5).

**Courses of Preparation**

**Essential**:

NST Part IB Chemistry A *and* NST Part IB Chemistry B; a specific route is provided for those who have taken only NST Part IB Chemistry B but it is important to realise that the choice within the course will be reduced. No specific route is provided for those who have taken only NST Part IB Chemistry A, but it is possible to access Part II Chemistry from this starting point provided that additional directed reading is taken over the preceding vacation.

**Recommended**: Any Part IB NST subject complementary to either Part IB Chemistry A or Chemistry B e.g. Mathematics, Physics, Materials Science, and biological subjects with a molecular focus.

## Part II Earth Sciences

This course is taught by the Department of Earth Sciences.

**Aims**

1. to develop a working understanding of advanced 'core' concepts in a number of areas of Earth Sciences
2. to further develop appropriate practical, quantitative and interpretative skills;
3. to allow the students to develop skills of data analysis, map production and interpretation and report writing through the completion of their independent mapping projects;
4. to develop advanced IT skills including use of computer graphics and GIS packages and other computer-based data analysis programs;
5. to become familiar with locating, reading and critically evaluating the high-level scientific literature by following up reading lists, using bibliographic search tools, and completing essays for supervisions.

**Learning Outcomes**

By the end of the course, students should:

1. have developed an advanced understanding of several specialised areas of geological science;
2. be appropriately prepared either to continue to a more research-oriented fourth-year course in Earth Sciences (MSci), or to graduate as a geologist with a broad scientific training and an advanced understanding of a number of areas of Earth Sciences.

**Teaching and Learning Methods**

The course is taught through lectures and practical classes, field trips and supervisions, and through a program of seminars. Students develop their independent learning skills through their mapping project, and develop their communication skills through both report-writing and presentation of short seminars.

**Assessment**

Assessment for this course is by:

- unseen written examination: students sit three written papers (for aims 1 and 3-5 and learning outcomes 1-2);
- unseen practical examinations, or continuously assessed practical tests (for aims 1-4 and learning outcomes 1-2);
- submission of a report of a piece of independent project work (usually based on a field mapping exercise) (for aims 2-5 and learning outcomes 1-2);
- an oral examination with an external examiner (for aims 1-5 and learning outcomes 1-2).

**Courses of Preparation**

**Essential**: NST Part IB Earth Sciences A *and/or* NST Part IB Earth Sciences B

## Part II Genetics

This course is taught by the Department of Genetics.

**Aims**

1. to provide a high quality broadly-based education across the range of the subject including molecular studies, genomics, population and evolutionary genetics;
2. to provide a stimulating and challenging learning environment where students are encouraged to learn for themselves and to engage in debate about the applications of genetic knowledge;
3. to provide training in the principles and practice of scientific research through a research project, and skills and experience in the evaluation of the results of such research;
4. to provide opportunities to develop presentational skills, analytical and problem solving skills, that can be used in the student's future career.

**Learning Outcomes**

By the end of the course students should have:

1. knowledge of the theoretical and experimental foundations of classical and modern genetics;
2. understanding of the broad applications of genetics throughout biology;
3. specialised knowledge and understanding of selected aspects;
4. experience and appreciation of research skills by means of a project;
5. experience of computer analysis of genetic and genome data;
6. developed skills in literature searching and in critical analysis of information;
7. developed skills in written and oral presentations.

**Teaching and Learning Methods**

These include lectures, seminars, journal criticism and problem solving sessions, supervisions and group discussions.

**Assessment**

Assessment for this course is by:

- five unseen written papers (for aims 1-4 and learning outcomes 1-3, 6 and 7);
- a dissertation and a research project in the same scientific area (for aims 3 and 4 and learning outcomes 3-7).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: NST Part IA Biology of Cells;
NST Part IB Cell and Developmental Biology;
A Level Biology
In addition NST Part IA Evolution & Behaviour, IA Mathematical Biology, IB Evolution & Animal Diversity provide valuable introductions to evolutionary and population genetics; NST Part IB Mathematical & Computational Biology provides useful skills for students interested in mathematical genetics.

## Part II History and Philosophy of Science

This course is taught by the Department of History and Philosophy of Science.

**Aims**

1. to provide a challenging course in the history, philosophy and sociology of science and medicine;
2. to develop, in students from a range of backgrounds, including the natural sciences, medicine, history and classics, a broad understanding of central themes in the development of science and medicine;
3. to recognize the wide range of backgrounds of students taking Part II HPS by providing an appropriate range of courses, none of which require prior knowledge of the field;
4. to encourage the development of critical and synthetic skills in relation to the claims, arguments and development of the sciences, technology and medicine, and of the disciplines that make up HPS;
5. to maintain a close relationship between teaching and research so that students gain familiarity with the principal current issues in a large and fluid field;
6. to help students acquire the skills of research, analysis and communication necessary to producing supervision essays and coursework using traditional and electronic library and other resources, and to foster skill in oral communication through participation in seminars;
7. to encourage students, through supervised work on a research project leading to the writing of a dissertation, to analyse in greater depth a topic in HPS that they find interesting and important;
8. to introduce students to historical, philosophical and sociological methods;
9. to encourage critical analysis of texts, objects and visual images.

**Learning Outcomes**

At the end of the course students should:

1. have increased confidence in their ability to think for themselves;
2. possess a thorough knowledge of selected areas in history, philosophy and sociology of science and medicine;
3. be capable of researching unfamiliar subject areas quickly and efficiently;
4. possess substantially improved skills in written and verbal communication;
5. be capable of pursuing an in-depth project.

**Teaching and Learning Methods**

These include lectures, supervisions, research work, group discussions, class presentations, and extensive reading.

**Assessment**

Assessment for this course is through coursework (up to 40%) and unseen examinations, See Programme Structure for details of Option A and Option B.

**Programme structure**

There are two alternative options for students taking the Part II in History and Philosophy of Science.

Option A consists of:

- three unseen written examinations chosen from a list of papers (for aims 2, 4, 5 and 9 and learning outcomes 1, 2 and 4);
- a dissertation of up to 8,000 words (for aims 7-9 and learning outcomes 3-5).
- one primary source essay of up to 5,000 words (for aims 5, 6, 8 and 9 and learning outcomes 3-4);

Option B consists of:

- four unseen written examinations chosen from a list of papers (for aims 2, 4, 5 and 9 and learning outcomes 1, 2 and 4);
- one primary source essay of up to 5,000 words (for aims 5, 6, 8 and 9 and learning outcomes 3-4);

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: The course presupposes no knowledge of the more elementary material covered by NST Part IB History and Philosophy of Science, but students who have not taken this course are advised, before the start of the Part II course, to read as many as possible of the texts listed in the leaflet 'History and Philosophy of Science Part IB'. All intending Part II students are urged to tackle the preliminary reading for the papers they plan to take during the Long Vacation and to discuss possible paper and dissertation topics with their HPS Director of Studies as soon as possible.

## Part II Materials Science

This course is taught by the Department of Materials Science & Metallurgy.

**Aims**

Part II Materials Science is aimed at developing a thorough understanding and knowledge across all aspects of Materials Science as well as developing practical skills, working in small teams and using industrially relevant equipment. The course aims to train interdisciplinary scientists with a range of theoretical and applied skills who will be well prepared to move on either to one of a wide range of careers, or to continue further study at Masters level, whilst developing transferable skills which have use beyond the study of science and technology.

**Learning Outcomes**

At the end of the Part II Materials Science course the students will be expected to have:

1. acquired deep understanding and knowledge of a wide range of materials and how their properties can be experimentally determined or theoretically modelled;
2. designed, performed and analysed experiments to characterise materials and devices;
3. developed practical laboratory skills, together with thorough knowledge of health and safety;
4. developed significant skills in the areas of quantitative analysis, scientific reasoning and communication;
5. carried out an in-depth literature review into an area of Materials Science research;
6. carried out a team project to investigate a manufactured item, determine the materials and processes used, and presented these results in a joint report;
7. developed transferable skills in areas including computing or languages;
8. designed, fabricated, characterised and evaluated an alloy against a pre-defined specification, in small groups;
9. gained awareness of the landscape for future opportunities in training or employment beyond Part II.

**Teaching and Learning Methods**

These include lectures, supervisions, examples classes, revision clinics, practical experiments, a materials manufacturing project, an alloy design project, a literature review, industrial visits and presentations.

**Assessment**

Assessment for this course is through:

- four unseen written examinations, based on lecture material;
- laboratory notes recording practical work performed;
- a literature review;
- a group report on the materials manufacturing project;
- a written proposal, poster, and presentation on the group alloy design project;
- assessed work for transferable skills, and the business and industry programme.

**Courses of Preparation**

**Essential**: NST Part IB Materials Science.

## Part II Pathology

This course is taught by the Department of Pathology.

**Aims**

1. to provide students with the opportunity for detailed study of the core principles of Pathology and to acquire specialised knowledge and understanding of selected aspects of Pathology;
2. to provide a stimulating and challenging learning environment where teaching is informed and enhanced by research, and to provide training in scientific principles and experience in the evaluation and practice of research;
3. to provide students with analytical and presentational skills.

**Learning Outcomes**

At the end of the course, students should:

1. have a specialised knowledge and understanding of key aspects of the scientific basis of disease;
2. have developed skills in the analysis of arguments and data from research papers and of reasoned argument in written and oral presentation of scientific investigations;
3. have research experience and developed basic skills by means of a project.

**Teaching and Learning Methods**

These include lectures, research seminars, supervisions, data-handling classes, small group teaching and experimental research.

**Assessment**

Assessment for this course is through:

- four unseen written examinations (for aims 1-3 and learning outcomes 1-3);
- one unseen data-handling examination (for aims 1-3 and learning outcomes 1-3);
- an extended essay and a written report based on the same research project undertaken by the student over the Michaelmas and Lent Terms (for aims 1-3 and learning outcomes 1-3).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: NST Part IB Biology of Disease

## Part II Pharmacology

This course is taught by the Department of Pharmacology.

**Aims**

1. To provide a wide-ranging, balanced and critical understanding of pharmacology as it relates to understanding mechanisms of drug action
2. To equip you with a range of skills for your future career, whether it is in life sciences research, medicine, veterinary medicine, drug discovery, or other careers not directly related to pharmacology

**Learning Outcomes**

At the end of the course students should:

1. be able to think critically and with appropriate knowledge over a wide range of pharmacological topics;
2. be able to communicate their own results and the work of others to scientific and more general audiences in both oral and written presentations;
3. be able to undertake searches of the scientific literature as the basis for critical evaluation of the retrieved information;
4. be able to critically assess different methods to solve pharmacological problems.
5. be able to analyse and assess their own research methods and results obtained during their research project

**Teaching and Learning Methods**

These include lectures, supervisions, discussion groups, technique talks and research projects.

**Assessment**

Assessment for this course is through:

- three unseen essay examinations (for aims 1-2 and learning outcomes 1-4);
- one data handling examination paper (for aims 1-2 and learning outcomes 1-4);
- a dissertation based on a research project undertaken by the student over an eight-week period (for aim 2 and learning outcomes 2-5);
- judgement of the student's oral presentational skills by examiners (for aim 2 and learning outcomes 2 and 3).
- a critical essay of no more than 2500 words (for aims 1-2 and learning outcomes 1-4).

**Courses of Preparation**

**Essential**: One Part IB biological subject *or* Chemistry A and/or B.

**Recommended**: NST Part IB Pharmacology;

## Part II Physics

This is a full-time course, taught by the Department of Physics. All students make choices between more experimental and more theoretical options. Half Subject Physics in NST Part II Physical Sciences consists of about half the Part II of the course.

**Aims**

1. to establish the final part of the core understanding of physics at a professional level;
2. to introduce new themes including a full development of statistical mechanics, advanced quantum theory, and electromagnetism and an introduction to relativity, as well as a range of optional courses;
3. to provide experience in a number of skills important to professional physicists;
4. to broaden awareness of the breadth of the subject and its major applications, and to provide an understanding of the importance of scientific communication;
5. to provide a sound basis in general physics, judged at the highest international standards.

**Learning Outcomes**

At the end of the course students should

1. have mastered further powerful tools for tackling a wide range of topics, including formal methods in classical and quantum physics;
2. have consolidated their ability to apply computers to the solution of problems in physics;
3. have written a report on at least one element of the coursework;
4. for those taking a theoretical option, have developed both classical and quantum theoretical techniques to the point where they could be used in research;
5. for those taking an experimental option, have gained experience of major experiments lasting about two weeks, and reached the point of being ready for experimental research;
6. be ready to undertake professional work in physics at a high level.

**Teaching and Learning Methods**

These include lectures, supervisions and practical and examples classes, practical computer programming, and supervised report writing. Unexamined lectures are also provided, including talks on current research.

**Assessment**

Assessment for this course is by

- seven or eight unseen examinations, based on lectures (for aims 1, 2 and 5 and learning outcomes 1 and 6);
- assessed coursework (for aims 3-5 and learning outcomes 1-6).

The assessment of coursework includes oral assessment of a Research Review or Physics Education reports (if offered) and may include oral assessment of a Computing Project report. It may also include up to two written tests on theoretical topics taken during the year, and oral assessment of up to two major experiments reports. Communication skills are appraised in all coursework assessments.

**Courses of Preparation**

**Essential**: NST Part IB Physics A and Physics B

## Part II Physiology, Development and Neuroscience

This course is taught primarily by the Department of Physiology, Development and Neuroscience.

**Aims**

1. to attract outstanding students to work in Physiology, Development and Neuroscience whether from natural science, medical or veterinary backgrounds;
2. to provide an intellectually stimulating lecture and project programme in which students can develop their understanding of the subject to the best of their potential;
3. to develop and maintain the highest academic standards of teaching, and to develop new areas of teaching and assessment in response to rapid advances in the subject;

**Learning Outcomes**

At the end of the course, students should have:

1. obtained an introduction from the course as a whole to Physiology, Development and Neuroscience at Honours level, emphasising the broadly based nature of the subject;
2. obtained some experience of independent investigation whether through completion of an experimental project or written dissertation;
3. developed the ability to evaluate critically results from their own or others' experiments;
4. developed transferable skills and responsibility for their own learning;
5. developed their capacity to argue and think in the biomedical sciences.

**Teaching and Learning Methods**

Each module contains a mixture of didactic lectures, seminars, journal clubs, supervisions and interactive workshops as appropriate to the material being covered. Students are also expected to present a poster on their experimental project or written dissertation, where students receive informal feedback from academics and their peers.

**Assessment**

- four written papers (for aims 1-2 and learning outcomes 1 and 3-5);
- a research project of up to 8,500 words (for aims 1-2 and learning outcomes 1-5).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: NST Part IA Physiology of Organisms *and*
NST Part IB Physiology *and/or* Neurobiology *and/or* Cell & Developmental Biology

## Part II Plant Sciences

This course is taught principally by the Department of Plant Sciences. Students may also attend inter-departmental modules run in conjunction with the Departments of Zoology and Genetics, as well as some options within the Part II Zoology course.

**Aims**

1. to provide an up-to-date review of several aspects of plant sciences and microbiology, including specialised techniques and experimental approaches used in modern plant and microbial sciences research;
2. to enable students to acquire specialised knowledge of selected areas of plant sciences and microbiology;
3. to provide training in research skills through an independent research project in a laboratory or field-based context, lasting twelve weeks;
4. to provide training in both scientific and transferable skills, including in oral and written presentation, which will serve as a lasting and practical basis for a career in industry, pure or applied biology, teaching, publishing or management.

**Learning Outcomes**

At the end of the course, students should:

1. be able to demonstrate advanced knowledge and understanding in several aspects of modern plant and microbial sciences research, and to analyse critically research literature;
2. be able to design and execute a research-based experiment, and to interpret the data obtained;
3. have acquired knowledge of how research is presented through having produced a written report on their research project.

**Teaching and Learning Methods**

These include lectures, supervisions, workshops, research work and seminars.

**Assessment**

Assessment for this course is through:

- four unseen written examinations (for aims 1-2 and learning outcome 1);
- a written report of no more than 5000 words of the major objectives and finding of the research project (for aim 4 and learning outcome 2 and 3);
- a critical essay of no more than 2500 words on a topic unrelated to the research project (for aims 1, 2 and 4 and learning outcome 1).

**Courses of Preparation**

**Recommended**: Any Part IA or Part IB biological subject.

## Part II Psychology

This course is taught by the Department of Psychology. It allows two options: students taking Option A will study lecture courses that will cover the core domains in psychology identified by the British Psychological Society (BPS) as required for BPS accreditation of the degree programme; students taking Option B may study lecture courses that allow a specialisation in psychology, neuroscience and behaviour, including courses that are not identified by the British Psychological Society (BPS) as required for BPS accreditation of the degree programme.

**BPS Accreditation**
For those who have met the examination requirements for NST IA Mathematical Biology, NST IB Experimental Psychology and NST Part II Psychology Option A, the degree awarded is recognised by the British Psychological Society as conferring 'graduate basis for registration', an essential prerequisite for postgraduate training and practice in certain professional branches of psychology. Option B is not accredited by BPS.

**Aims**
1. to provide teaching to students via lecture courses from several areas of experimental psychology and cognitive neuroscience;
2. to provide students with freedom of choice to specialise in particular areas;
3. to provide students with a training in experimental psychology and cognitive neuroscience which would enable them to subsequently pursue advanced education and/or training in related areas.

**Learning Outcomes**
At the end of the course, students should have:
1. developed conceptual tools required for analysis of mind, brain and behaviour;
2. extended their knowledge and understanding of selected topics to the frontiers of research;
3. gained experience of psychological research and scientific reporting, through the conduct and writing up of a supervised research project;
4. learnt and exercised techniques of statistical analysis commonly used in experimental psychology and cognitive neuroscience;
5. had the opportunity to develop the skills of literature research, critical review and extended expository writing through preparing a dissertation.

**Teaching and Learning Methods**
These include lectures, project supervisions, supervisions on lecture material, and a self-taught statistics course.

**Assessment**
Assessment for this course is through:
- four unseen written examinations, based on the content of lecture courses (for aims 1, 2 and 3 and learning outcomes 1, 2 and 4);
- submission of a research report of experimental work conducted with the guidance of a supervisor (for aim 3 and learning outcomes 3 and 4);
- an *optional* dissertation (for aims 2 and 3 and learning outcomes 1, 2 and 5).

**Courses of Preparation**

**Essential**: *None.*

**Recommended**: NST Part IB Experimental Psychology *and/or* Neurobiology.

## Part II Zoology

This course is taught within the Department of Zoology, by members of staff of that Department together with some from other University Departments and external organisations.

**Aims**

1. to provide a broad multidisciplinary course in Zoology;
2. to train students in a wide range of science-based skills that provide the learning base for future careers in disciplines such as health sciences, agriculture, environmental management, biotechnology, publishing, teaching, research and management;
3. to offer a modular course of lectures and associated seminars, research projects, an optional field course and excursions, supported by supervisions where appropriate;
4. to promote training in practical and conceptual skills in sub-disciplines ranging from molecular cell biology, through behaviour and neurobiology, to the ecology, evolution and conservation of populations;
5. to provide constructive feedback on students' progress by assessing individual students throughout the year in their project work, participation in seminars and written work for supervisions;
6. to provide an optional Zoology-based course in statistics in the Michaelmas Term enabling students to apply quantitative methods to complex biological problems;
7. to provide professional training in effective verbal and written communication skills including practical experience of research talks;
8. to provide training in writing research project proposals.

**Learning Outcomes**

At the end of the course students should be able to:

1. think critically in terms of their learning and research;
2. evaluate critically the published literature;
3. assess and implement the practical techniques necessary to solve a particular biological problem;
4. quantify and analyse data collected during a research project;
5. communicate with expert and non-expert audiences, both orally and in writing.

**Teaching and Learning Methods**

These include lectures, supervisions, journal clubs, excursions and an optional field course. We also run a series of Special Seminars for Part II students, covering postgraduate study and careers, and teaching students study skills such as reading a paper, research reproducibility and figure preparation Departmental research seminars.

**Assessment**

Assessment of this course is through:

- four unseen written examinations (for aims 2, 4, 6 and 7 and learning outcomes 1-5);
- two reports each of no more than 5,000 words based on two research projects *or* one report of no more than 7,500 words based on a single research project. Students also give a 15 minute assessed oral presentation on their research project (for aims 2, 4, 6 and 7 and learning outcomes 1-5);
- a research project proposal of no more than 2,000 words (for aims 2, 4, and 7 and learning outcomes 1-5).

**Courses of Preparation**

**Essential**: *None.*

## Part II Biological and Biomedical Sciences

This course consists of material taught in other courses within the Natural Sciences Tripos and other Triposes.

**Aims**

1. to provide a route for students who would prefer a broader biological curriculum than that offered in single subject Part II courses
2. to provide an education of the highest calibre in biosciences leading to graduates of the quality sought by the professions, the public service, and industry
3. to provide an intellectually stimulating and challenging learning environment in which students have the opportunity to develop their skills and enthusiasms to the best of their potential
4. to provide training in scientific principles and experience in evaluation of research
5. to contribute to the national needs for practitioners and leaders in the sciences, medical and veterinary professions

**Learning outcomes**

At the end of the course students should have:

1. an advanced, in depth, understanding of the core principles and their experimental basis of a chosen major subject.
2. additional advanced understanding of a more limited area in a chosen minor subject
3. experience of independent work, including an introduction to aspects of scientific research skills
4. developed skills in analysis of arguments and data from research papers.
5. developed skills of reasoned argument in written and oral scientific investigations and exegesis
6. verbal and written communication skills

**Teaching and Learning Methods**

These include lectures, supervisions and seminars.

**Assessment**

Students offer the written papers of a chosen biological science subject in Part II of the Tripos together with one additional paper chosen from another Part II biological science or another Tripos. Students also offer a 6000-word dissertation. Students are advised to review the pages of the programme specification in the subjects offered.

## Part II Physical Sciences

This course consists of material borrowed from other courses offered within the Natural Sciences Tripos and elsewhere.

**Aims**

1. to provide a route for students who would prefer to follow a broader curriculum in physical sciences than that offered in other Part II courses;
2. to provide a course for students who have decided on a career more suited to a broad scientific background and have concluded that a more research-oriented single subject Part II would not meet their needs.

**Learning outcomes**

At the end of the course students should:

1. be able to apply the ideas and concepts introduced in the courses to solve problems, make predictions and rationalise trends;
2. have a deeper understanding in selected areas of physical science;
3. have enhanced practical skills, particularly in the areas of making and interpreting measurements.

**Teaching and Learning Methods**

These include lectures, supervisions and practical classes.

**Assessment**

Students offer a subset of the examinations required for their Part II Half Subject in Chemistry, Physics or Earth Sciences, the examination requirements for their chosen Part IB subject, and a 5,000-word dissertation.

## Part III Astrophysics

This course is taught by the Institute of Astronomy.

**Aims (common to both Part II and Part III)**

1. to encourage work of the highest quality in astrophysics and maintain Cambridge's position as one of the world's leading centres in the field;
2. to continue to attract outstanding students from all backgrounds;
3. to provide an intellectually stimulating environment in which students have the opportunity to develop their skills and enthusiasms to the best of their potential;
4. to maintain the highest academic standards in undergraduate and graduate teaching and to develop new areas.

**Learning Outcomes**

Students completing the fourth year should have:

1. had experience of a number of areas of astrophysics from a choice of options taken to an advanced level, at which current research can be appreciated in some depth;
2. carried out a substantial research project amounting to about 1/3 of the work in the course;
3. enhanced their communications skills;
4. become well prepared for a career in academic research or one where independent research skills are required.

**Teaching and Learning Methods**

These include lectures and examples classes, and guidance in undertaking research projects.

**Assessment**

Assessment for this course is through:

1. a written examination for each chosen lecture course. One and a half, two or three hours are allocated per paper depending on the subject (for aims 1-4 and learning outcomes 1, 3 and 4);
2. a written report on the research project of no more than 30 pages, and an oral presentation based on it (for aims 1-4 and learning outcomes 1-4).

**Courses of Preparation**

**Essential:** NST Part II Astrophysics, NST Part II Physics or Mathematical Tripos Part II with a first or good upper second result with alphas scored in at least three different theoretical Physics courses.

## Part III Biochemistry

This course is taught by the Department of Biochemistry.

**Aims**

To build on Part II Biochemistry to deepen and extend research-level knowledge and integrated understanding of the scientific methods and processes. To study selected specialised aspects by means of lectures, and to develop research skills and knowledge of research techniques and instrumentation by means of seminars, lectures and a two-term research project.

**Learning Outcomes**

At the end of the course students should be able to:

1. demonstrate advanced knowledge and understanding in additional selected specialist areas;
2. demonstrate knowledge of the objectives, methods, results and conclusions of their research project by means of interim and final seminars to an audience of their peers and departmental staff;
3. demonstrate knowledge of the written presentation of research through the production of a report on their research project;
4. analyse critically research literature and contemporary biochemical topics, and present such analyses in both written and oral formats;
5. adopt a problem-solving approach to experimental data;
6. explain the importance and impact of scientific topics to the non-specialist;
7. demonstrate knowledge of cutting-edge experimental techniques designed to underpin the strong research focus of Part III.
8. demonstrate knowledge of key papers that have significantly influenced the development of the subject.

**Teaching and Learning Methods**

These include two advanced modules of 12 lectures in the first term, on “Molecular Recognition and Interaction” and “Cell Fate” of which students attend one, and two in the second term, on “Contemporary Cancer Studies” and “The Biochemistry and Biophysics of Neuronal and Metabolic Disorders” of which students attend one. In both terms there are regular seminars on “Scientific Method and Experimental Design”. There are also short courses on research skills, a two-day course on laboratory safety, supervisions, journal clubs with guided detailed analysis of a research paper, classes in data handling, research work, peer group sessions with opportunities for oral presentations and debate of contemporary biochemical topics and issues of science that affect society.

**Assessment**

Assessment for this course is through:

- one unseen essay examination paper to examine the advanced modules, requiring two essays covering the chosen first term module and two essays covering the second term module (for aim 1 and learning outcomes 1 and 4);
- one unseen examination paper to assess the journal clubs and seminar series (for aim 1 and learning outcomes 4, 5, 7 and 8) containing two sections of equal weight: the first section requires critical evaluation of a research article; the second section requires an integrated scientific essay;
- a dissertation of no more than 8000 words, based on a research project undertaken over two terms (for aim 1 and learning outcomes 1-7);
- an oral examination centred on the subject of the dissertation (for aim 1 and learning outcomes 1, 2 and 4-7).

**Courses of Preparation**

**Essential**: NST Part II Biochemistry

## Part III Chemistry

This course is taught by the Department of Chemistry.

**Aims**

1. to build on the knowledge and ideas gained from Part II Chemistry;
2. to develop, in selected areas, an understanding of chemistry which will allow the student to appreciate and begin to develop a critical understanding of current research topics, especially those represented in the Department;
3. to undertake a substantial and novel research project under the direction of a member of staff, and thereby to gain an understanding of relevant research techniques, and the design and interpretation of experiments;
4. to learn how to present their results both orally and in writing.

**Learning Outcomes**

At the end of the course students should:

1. be able to apply the ideas and concepts introduced in the course to solve problems, make calculations, make predictions and rationalize trends and critically evaluate information and data;
2. be able to demonstrate their continuing ability to understand and apply fundamental concepts in chemistry;
3. have developed general practical, organizational and presentational skills which will enable them to continue with research;
4. be able to demonstrate the necessary skills and knowledge required for a career as a professional chemist.

**Teaching and Learning Methods**

These include lectures, supervisions, examples classes and a research project.

**Assessment**

Assessment for this course is through:

- three unseen written examinations (for aims 1-2 and learning outcomes 1, 2 and 4);
- submission of a dissertation of 5000 words (for aims 3-4 and learning outcomes 3-4);
- presentation to their research group and oral examination on the content of the dissertation (for aims 3-4 and learning outcomes 3-4).

**Courses of Preparation**

**Essential**: NST Part II Chemistry

## Part III Earth Sciences

This course is taught by the Department of Earth Sciences primarily for those students intending to continue their academic studies at the post-graduate level.

**Aims**

1. to expose advanced students to the breadth of the Earth Sciences through a combination of seminars, course work and field trips;
2. to provide “state of the art” knowledge of specific areas in the Earth Sciences through a combination of seminars, course work, and faculty-supervised independent research;
3. to develop the conceptual and practical skills necessary for independent research;
4. to develop communication and presentation skills to an advanced level.

**Teaching and Learning Methods**

The course is taught via:

1. an original, in-depth research project, supervised by one or more members of staff;
2. weekly seminars, presented by both visiting and in-house Earth scientists;
3. course work and associated practical classes and library reading, organised into at least 10 “options” (of which students are required to take six); including interdisciplinary options hosted by Earth Sciences, Physics and Chemistry;
4. small-group supervisions;
5. direct experience in communicating results in the form of student seminars and a poster presentation of research project results.

**Assessment**

Course performance is assessed on the basis of:

- an independent, original, research project, conducted primarily over the course of the first term, but written up and submitted in the second term (for aims 1-4);
- one unseen written examination of 3 hours based on Department seminars and fieldwork (for aims 1-4);
- six unseen written examinations of 2 hours, covering aspects of the option courses (for aims 1-4);
- at least one unseen practical examination, covering practical aspects of the option courses (for aims 1-3);
- submission of a record of practical and field work during the year (for aims 1-4);
- an oral examination with an external examiner (for aims 1-4).

**Courses of Preparation**

**Essential**: NST Part II Earth Sciences

## Part III History and Philosophy of Science

This course is taught by the Department of History and Philosophy of Science.

**Aims**

1. to give students with relevant experience at Part II the opportunity to carry out focussed research in History and Philosophy of Science under close supervision;
2. to give students the opportunity to acquire or develop skills and expertise relevant to their research interests;
3. to enable students to acquire a critical and well informed understanding of the roles of the sciences in society;
4. to help students intending to go on to doctoral work to acquire the requisite research skills and to enable them to prepare a well-planned and focused PhD proposal.

**Learning Outcomes**

By the end of the course, students should have:

1. developed a deeper knowledge of their chosen area of HPS and of the critical debates within it;
2. acquired a conceptual understanding that enables the evaluation of current research and methodologies;
3. formed a critical view of the roles of the sciences in society;
4. acquired or consolidated historiographic, philosophical, linguistic, technical and ancillary skills appropriate for research in their chosen areas;
5. demonstrated independent judgement, based on their own research;
6. presented their own ideas in a public forum and learned to contribute constructively within an international environment.

**Teaching and Learning Methods**

The course is taught via:

- lectures; personal study; weekly participation in the research seminar and regular participation in others of the department's seminars and reading groups; regular one-to-one supervisions;
- students requiring linguistic skills are directed to the relevant University language centre classes; students needing Latin are directed to the relevant classes in the Classics Faculty and take part in the Department's Latin Therapy group; students working on scientific instruments receive specialist training from the Museum Curator and Museum Staff.

**Assessment**

Course performance is assessed on the basis of:

- two research papers, each of not more than 5,000 words on topics chosen in discussion with a supervisor and approved by the HPS Board; (aims 1-4 and learning outcomes 1-5)
- two set essays, each of not more than 2,500 words, from a list of topics drawn from those covered by the weekly research seminar; (aims 1-3 and learning outcomes 1-5)
- a dissertation, of not more than 12,000 words on a topic chosen in discussion with a supervisor and approved by the HPS Board (aims 1-4 and learning outcomes 1-5).

## Part III Materials Science

This course is taught by the Department of Materials Science and Metallurgy.

**Aims**
Part III Materials Science focusses on recent developments at the cutting edge of Materials Science. There is great flexibility of choice from a range of lecture courses available, which are informed by the research activity in the department. A significant aspect of the course is an individual research project, whose aim is to provide training in research skills and via a broad range of assessment methods develop transferable oral and written skills. Those graduating from this Masters-level course will be highly trained scientists who will be well positioned to move into further academic research, scientific industry or other careers.

**Learning Outcomes**
At the end of the Part III Materials Science course, students will be expected to have:
1. the ability to solve problems, carry out calculations, make predictions and critically evaluate information and ideas all at an advanced level;
2. acquired specialised understanding and knowledge of a number of materials systems and an awareness of the latest state of research and developments in those areas;
3. acquired practical, organisational and presentational skills that will enable them to continue successfully with research or in other professional careers;
4. carried out an individual research project in an area of current relevance, communicating the results clearly via written reports, an oral presentation, a poster and a viva-voce examination;
5. completed a professional placement activity and delivered oral and written presentations on the subject.

**Teaching and Learning Methods**
These include lectures, supervisions, examples classes, revision clinics, individual research projects, and presentations.

**Assessment**
Assessment for this course is through:
- three unseen written examinations;
- reports based on an individual research project undertaken by the student over 2 terms, plus an oral presentation and a viva;
- a report based on a placement undertaken by the student during a preceding long vacation period plus an oral presentation.

**Courses of Preparation**

**Essential:** NST Part II Materials Science

## Part III Physics

This is a full-time course, organised and mainly taught by the Department of Physics. Some in-house courses may be taught by staff from other Departments, such as Earth Sciences, the Institute of Astronomy, and Addenbrookes Hospital. Some courses are interdisciplinary courses shared across several NST Part III courses or may be borrowed from other triposes, for example from Part III of the Mathematical Tripos and Part IIB of the Engineering Tripos. All students make choices from Major and Minor Topics.

**Aims**

1. to expose students to a wide range of areas of physics at a level which will give them a critical understanding of current research;
2. to give all students experience of research by carrying out an original project, often at a level capable of publication;
3. to provide what is needed to proceed to research or other activity in physics (and other sciences) at the highest international standards.

**Learning Outcomes**

At the end of the course students should:

1. have had experience of a number of broad areas of physics from a choice of options, taken to an advanced level, at which current research can be appreciated in some depth;
2. have carried out a substantial independent research project experimental or theoretical work, or both;
3. have further developed their communication skills especially in writing up the project and in presenting it to their peers or research group;
4. be ready to undertake research work in physics at the highest level.

**Teaching and Learning Methods**

These include lectures, supervisions and examples classes, supervised project work and report writing, and, in some cases, supervised project work outside the Department.

**Assessment**

Assessment for this course is through:

- unseen examinations on three or more of the Major Topics, taken at the start of the Lent Term (for aims 1 and 3 and learning outcomes 1 and 4);
- unseen examinations on three or more of the Minor Topics, interdisciplinary subjects or shared courses, normally taken at the start of the Easter term (for aims 1 and 3 and learning outcomes 1 and 4);
- Written report and oral examination of the Research Project (for aims 2 and 3 and learning outcomes 2, 3 and 4).

It may also include coursework assessment of the Innovation and Entrepreneurship for Physicists course, taken in lieu of one Minor Topic.

**Courses of Preparation**

**Essential**: NST Part II Physics.

## Part III Systems Biology

The Schools to be involved in delivering the taught parts of the Course include: Biological Sciences (Departments of Biochemistry, Genetics, Pathology, Plant Sciences and the Sainsbury Laboratory); Physical Sciences (DAMTP). Additional material will be contributed by local Institutes which may include the European Bioinformatics Institute (EBI); MRC Laboratory for Molecular Biology (LMB); Cancer Research UK; Cambridge Research Institute (CRI); MRC Toxicology Unit.

**Aims**

1. To acquaint students with backgrounds in the biological, physical, mathematical or computational sciences with the concepts and techniques of each other's disciplines that are relevant to an integrated approach to the study of living systems.
2. To equip students with the skills to generate comprehensive biological data sets, analyse them using appropriate statistical techniques, and use such data to generate mathematical or computational models of biological systems with predictive and explanatory power.

**Learning Outcomes**

At the end of the course a student should be able to:

1. demonstrate advanced knowledge and understanding of the biological, computational, , mathematical, and physical sciences relevant to the integrative study of living systems;
2. demonstrate knowledge of the objectives, methods, and efficacy of their team project by presenting a computer model/simulation to their peers and academic staff;
3. demonstrate knowledge of the objectives and methods of their individual research project by means of presentations to their peers and academic staff soon after the start of their individual research projects;
4. demonstrate knowledge of, and ability to present the objectives, methods, results and conclusions of their individual research projects through the production of a report;
5. analyse and critically research literature and contemporary topics in systems biology, and present such analyses in written and oral formats;
6. adopt a model-building approach to the analysis of large-scale experimental data;
7. explain the importance and impact of topics in systems and biology to both non-specialists in the natural sciences and engineering and to the lay public;
8. demonstrate cutting-edge computational and experimental techniques relevant to systems biology.

**Teaching and Learning Methods**

These include an Introductory and three specialist taught modules. Each module comprises both formal lectures and computer-based practical classes. One of the specialist modules will include a team project. Weekly discussion groups will alternate between Journal Clubs and seminars from external speakers. A 12-week individual research project will take place in the Michaelmas and Lent terms.

**Assessment**

Course performance is assessed on the basis of:

- three written papers; one paper of three and one quarter hours, one paper of three hours and one paper of two hours (for aims 1-2 and learning outcomes 1,5, 6, 7);
- a computer based practical examination of three hours;
- a practical report of a team project (for aims 1-2 and learning outcomes 2, 6, 8);
- a report of an individual research project of not more than 6,000 words, excluding footnotes and bibliography (for aims 1-2 and learning outcomes 3-6, 8)

## Part III Quantitative Climate and Environmental Science

The course is principally offered by the Department of Applied Mathematics and Theoretical Physics (DAMTP) and the Department of Earth Sciences (DES) with additional material contributed by the British Antarctic Survey (BAS) and member departments of the Natural Sciences Tripos. The course is designed to train students with a suitable level of mathematical skills in climate and environmental modelling and in environmental data collection and analysis. Multidisciplinary will be achieved through diverse topics addressed in the course, combined with a research project which will prepare students for careers in many sectors of the economy dealing with climate and environmental impacts.

**Aims**

The objectives of the course are

1. To expose students to a wide range of scientific areas and approaches related to climate and environmental change;
2. To give students quantitative skills and practical experience in climate and environmental modelling through combined theoretical and laboratory approaches;
3. To expose students to key techniques in the acquisition and analysis of field and laboratory data related to climate and environmental processes;
4. To give students the experience of conducting a research project in the area of climate and environmental processes;

**Learning Outcomes**

By the end of this course, students will:

1. Have experience with a broad number of areas of climate and environmental science from the core and options modules (Aims 1, 2, 3);
2. Have conducted a substantial independent research project (Aim 4);
3. Have developed their communication and presentation skills through the writing of lab and field reports (Aim 3), and through the write-up and presentation of their research project (Aim 4);
4. Be ready to undertake quantitative research and critical analysis of climate and environmental science at the highest level.

**Teaching and Learning Methods**

These include lectures, supervisions and examples classes, supervised project work and report writing, and, in some cases, supervised project work outside the Department.

**Assessment**

Assessment for this course is through:

- Two unseen written examinations taken at the start of the Lent term on the Fundamentals of Environmental Modelling and Atmosphere, Ocean and Cryosphere (for Aims 1 and 2);
- Submission of two short written reports due at the start of the Lent term on laboratory and numerical methods respectively, and longer report on environmental data acquisition and analysis also due at the start of the Lent term (for Aims 1 and 3);
- Examinations on three options courses, normally taken in the Easter term (for Aims 1, 2 and 3);
- A written report and oral presentation summarising the research project (for aims 1, 2, 3 and 4).

**Courses of Preparation**

**Essential**: NST Part II with one of NST IB QES or NST IB Mathematics, or Part II Mathematics.