



***St John's College
Larmor Society's***

*Natural Sciences Tripos
Subject Summaries Guide*

Introduction

Hello fellow NatSci!

I'm Juliette, I'm a second year NatSci and I'm your Academic Affairs Officer. I've compiled this 'Subject Summaries Guide' for anyone making subject choices within the Natural Sciences Tripos. Whether you're an incoming fresher or a fully-fledged NatSci embarking on your second year at Cambridge, I hope that you will find this guide useful in helping you decide which options to take.

For each subject at Part IA and Part IB, I have compiled the following information:

- Pre-required knowledge for the course*
- Lab schedule*
- A brief topic breakdown*
- Forms of assessment for the course*
- Bits of advice and other comments from students who have already taken the course*

For each Part IB subject, I have also added a section called 'Progression' – this gives you an idea of what 3rd year subjects specifically require or recommend the IB course in question.

At the end of each section, I have also included some examples of subject combinations that students have taken in the past, along with some advice on subject combinations – this is by no means a comprehensive list of all possible subject combinations, but it serves to give an idea of some of the popular combinations that students have taken in the past.

Should you have any further questions, please don't hesitate to get in contact with me at jrmr2@cam.ac.uk, or with anyone else on the committee – we're here to help you!

We wish you all the best of luck!

*Juliette Richards
Academic Affairs Officer 2022-2023*

P.S. Huge 'thank you' to all the students of St John's who helped me compile this resource – I couldn't have done it without you :)



PART IA

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Maths A / Maths B

PRE-REQUIRED KNOWLEDGE

- *Maths A Level, Further Maths A Level would be recommended for Maths B but still not essential (further maths topics will be covered in both courses, but at a very fast pace)*

LAB SCHEDULE

- *Four 2 hour 'Scientific Computing' sessions in Michaelmas, and another four sessions in Lent (all using Google Colab)*

TOPIC BREAKDOWN

- | | |
|---|---|
| <ul style="list-style-type: none">• <i>Vectors</i>• <i>Complex Numbers</i>• <i>Taylor Series</i>• <i>Methods of integration</i>• <i>Probability</i>• <i>Ordinary Differential Equations</i>• <i>Exact Differentials</i>• <i>Functions of several variables</i>• <i>Multiple integration</i> | <ul style="list-style-type: none">• <i>Line integrals</i>• <i>Vector fields</i>• <i>Matrices</i>• <i>Fourier Series</i>• <i>Leibnitz Formula*</i>• <i>Partial Differential Equations*</i>• <i>Lagrange Multipliers and Multivariable Functions with Constrained Optimisation*</i>• <i>Complex Integration*</i> |
|---|---|

NB Topics marked with an asterisk are taught in the B course only

ASSESSMENT

- *2 unseen 3 hour written papers (the same papers are taken by both Maths A and Maths B students, but since you have a choice of questions, Maths B students will have access to some additional questions on Maths B topics which Maths A students won't have the required knowledge to attempt)*
- *Each computing session is marked out of 2 and your total computing grade contributes about 7% to your NST IA Maths mark*

STUDENT COMMENTS

- *"There is no need to do Maths B if you're unsure about it, nobody is going to think better of you for doing it or worse of you for not doing it! Maths B is recommended for those who love maths and/or are strongly considering taking Maths at IB, but neither of these were the case for me and I don't regret taking the slightly easier option of Maths A at all"*
- *"I switched from Maths A to maths B after IA Michaelmas term as I kept falling asleep in the lectures; Maths B wasn't as difficult as they made it out to be"*
- *Maths B students tend to find that once they have grasped the additional content, the exam questions on these topics are easier than some of those on the core content, but additional time is spent during the year tackling these trickier topics and the example sheet questions on the core topics are harder than those given to Maths A students as well*

Mathematical Biology

PRE-REQUIRED KNOWLEDGE

- *A Level Maths is highly desirable, A Level Further Maths is helpful but not necessary*
- *Any student who did not study mathematics post-16 will need to take a more restricted version of the course, “Mathematical Biology A” as opposed to “Mathematical Biology B”, which involves attending a separate series of lectures in the final two weeks of Michaelmas term, and you will have a restricted choice*

LAB SCHEDULE

- *Once a week for 1 hour 15 mins every week on using R (a statistical programming language)*

TOPIC BREAKDOWN

- *Probability and matrices*
- *Statistics and statistical modelling*
- *Modelling biological systems using differential equations*
- *Modelling coupled dynamics*
- *Introduction to bioinformatics*
- *Modelling reaction kinetics*
- *Evolutionary modelling*

ASSESSMENT

- *One 3-hour exam, which includes 2 questions from each of the 5 sections of the course, of which you choose to answer 8, with at least one question from each section (80% of final grade)*
- *Coursework with R, made up of 1 exercise per term (20% of the final grade)*

STUDENT COMMENTS

- *“Most lectures are quite clear with calculation steps and R is not as daunting as it seems at first, even for complete coding beginners. The statistical models are not the best explained though and required a lot of self-study for me to completely understand it. It is a very time-consuming module if you are not the best at maths, but it’s not impossible”*

Biology of Cells

PRE-REQUIRED KNOWLEDGE

- *A Level Chemistry is highly desirable*
- *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 - an optional preliminary [reading list](#) is available on the NST website*

LAB SCHEDULE

- *On average 4 hours per week (a session from 11-1 followed by another from 3-5)*

TOPIC BREAKDOWN

- *Macromolecules*
- *Membranes*
- *The Chemistry of Life (metabolism, photosynthesis, etc)*
- *Mendelian Genetics*
- *Translation and Transcription of Genes, etc*
- *The Genetic Revolution*
- *Cell Proliferation*
- *Cell Signalling*
- *Development*

ASSESSMENT

- *One 3 hour theory paper based on lecture material, consists of short answer questions and a choice of essay questions, contributes 67% to your overall NST IA BoC grade*
- *One 3 hour written practical paper based on material covered in labs, contributes 33% to your overall NST IA BoC grade*

STUDENT COMMENTS

- *"I loved this course, it covers a vast range of biology at the molecular and cellular level and is a great choice for anyone interested in Biochemistry"*
- *"Super interesting course, but be prepared to be faced with a LOT of content"*
- *"It's taught by lots of departments and so lacks consistency in things like practical organisation and handout format"*
- *"Despite how the course organisers make it seem, it is a very difficult course without having done Biology A Level; if you're willing to put in the work to catch up with your peers then it's worth it, but don't underestimate how much time and effort this will take"*
- *"I was this close to dropping this course... only take it if you are genuinely interested in the content"*

Chemistry

PRE-REQUIRED KNOWLEDGE

- *A Level Chemistry or equivalent*
- *AS or A Level Maths is recommended*
- *Note that A Level Maths is essential for the Part IB Chemistry A option*

LAB SCHEDULE

- *One 11-5 session every other week with a one hour lunch break from 1-2*
- *Note that not all practicals will take you this long – you can leave as soon as you have finished the practical and write-up, so many students find that on average they will finish at more like 4pm or even earlier*

TOPIC BREAKDOWN

- *Shapes and Structures of Molecules*
- *Reactions and Mechanisms in Organic Chemistry*
- *Energetics and Equilibria*
- *Kinetics of Chemical Reactions*
- *Chemistry of the Elements*

ASSESSMENT

- *One 3 hour theory paper based on lecture material, contributes 80% to your overall NST IA Chemistry grade*
- *Practical write-ups are submitted at the end of each practical session (10 in total) – these continuously assessed practicals contribute the remaining 20% to your grade*

STUDENT COMMENTS

- *“Great course, the practicals were really interesting, and it improved my knowledge tenfold”*
- *“I really loved this module! It covers a whole range of physical, organic and inorganic chemistry, meaning that there is something interesting in it for everyone, whether you are a Phys or a Bio NatSci”*
- *“Chemistry IA is generally good since the department is friendly, well organised, and quite international”*
- *“The Chemistry department is big, organised and very precise”*

Earth Sciences

PRE-REQUIRED KNOWLEDGE

- *It is essential to have any two of Physics, Chemistry, Biology and Mathematics A Levels (but you will find that no prior knowledge is needed for this course, and you will be able to do this course having done any combination of the above A Levels)*

LAB SCHEDULE

- *3 one hour sessions a week (not assessed)*

TOPIC BREAKDOWN

- *Physical properties of planet earth*
- *Geology beyond the solar system*
- *Earth's climate system*
- *What is Earth made of? (Mineralogy)*
- *From minerals to rocks: how the crust works*
- *Palaeobiology*
- *Sedimentary processes and products*
- *Vertebrates*
- *Britain's geology*
- *Planet Earth: The bigger picture (applications)*
- *Arran field trip - one week in Easter holiday*

ASSESSMENT

- *3 hour practical exam (fossil analysis, rock and mineral identification, thin section analysis, map exercise)*
- *3 hour theory paper (calculation exercise, 3 long answer questions)*

STUDENT COMMENTS

- *"The department is super friendly, and the course is really well structured"*
- *"The field trips are a great opportunity to socialise"*
- *"This course is different to anything most people have done before but also is a nice way to apply your other subjects"*
- *"I did not like this course at all and found it really boring and dry. It also did not relate to my other modules (Cells, E&B and Math Bio) at all, which made it easy to ignore"*

Evolution and Behaviour

PRE-REQUIRED KNOWLEDGE

- *A Level Biology is recommended but not essential*

LAB SCHEDULE

- *In 2021-2022 there was a 1 hour 30 minutes session every other week (sometimes an online practical)*

TOPIC BREAKDOWN

- *Introduction to evolutionary biology*
- *Evolutionary genetics*
- *The first few billion years*
- *The origin and evolution of plants*
- *Diversification of angiosperms*
- *The evolution of animal diversity*
- *Evolution of behaviour*
- *Human evolution*
- *Ancient DNA and human population genetics*
- *Global change I: The Green Extreme*
- *Global change II: Biodiversity*

ASSESSMENT

- *One 3 hour theory paper based on lecture material, composed of five 40 minute essay questions, contributes to 75% of your NST IA E&B grade*
- *Some practical sessions have write-ups which you complete and submit online after the practical session and contribute 25% of your NST IA E&B grade*

STUDENT COMMENTS

- *"This course is really great if you have an interest in evolution as it focuses on that aspect more than behaviour, and I found myself really enjoying it"*
- *"It's one of the easier NST courses and Biology A-level definitely isn't needed, so that helped!"*

Materials Science

PRE-REQUIRED KNOWLEDGE

- *A Level Mathematics and either Chemistry or Physics is essential (although it is worth noting that there is very little assumed knowledge from these syllabuses and that their requirement is mainly skill based)*

LAB SCHEDULE

- *Weekly lab sessions 1 hour 15 minutes long (though this may be extended post-COVID)*

TOPIC BREAKDOWN

- *Atomic Structure of Materials*
- *Materials for Devices*
- *Diffraction*
- *Microstructure*
- *Mechanical Behaviour of Materials*
- *Biomaterials*
- *Materials Under Extreme Conditions*

ASSESSMENT

- *One 3 hour unseen written paper with a choice of five questions from seven provided, in total comprising 85% of the 1A Materials mark*
- *Continuously assessed work makes up 15% of the overall mark - pre-practical quizzes taken through the year make up 2.5%, rough lab notes make up another 2.5%, and the final 10% is marks contributed from the mini project report compiled during Lent term*

STUDENT COMMENTS

- *"Materials is a very well-presented course with reliable notes and good lecturers"*
- *"This course was really good, it was really interesting to learn about completely new things and study something I'd never thought about before"*
- *"The department is friendly and helpful which is a big plus"*
- *"Materials is amazing, and 1A doesn't get to show just how awesome it is!"*

Physics

PRE-REQUIRED KNOWLEDGE

- *A Level Physics and Maths, or A Level Maths and Further Maths (including the section on Mechanics)*
- *A Level Further Maths can be helpful, although you are required to take either Maths A or Maths B alongside Physics at IA and so any gaps in your maths knowledge will be filled in this way*

LAB SCHEDULE

- *One 2-5:45 session every other week*
- *Note that not all practicals will take you this long – you can leave as soon as you have finished the practical and write-up, so many students find that on average they will finish at more like 4:30pm or even earlier*

TOPIC BREAKDOWN

- *Dynamics*
- *Rotational Mechanics*
- *Special Relativity*
- *Oscillating Systems (including SHM in both mechanical and electrical systems)*
- *Waves and Quantum Waves*
- *Gravitational and Electromagnetic Fields*

ASSESSMENT

- *One 3 hour theory paper based on lecture material, contributes 75% to your overall NST IA Physics grade*
- *Practical write-ups are submitted at the end of each practical session (10 in total) – these continuously assessed practicals, along with two formal reports that are submitted during the year (one at the beginning of Lent and one at the beginning of Easter) contribute the remaining 25% to your grade*
- *Around a third of the practical mark comes from the formal reports – the first is a partial report based on an experiment carried out in Michaelmas, the second is a full report based on an experiment carried out in Lent*

STUDENT COMMENTS

- *“If you like the process of solving longer problems on your own and want to know where formulas come from a more fundamental level, you’ll enjoy this course – university physics is definitely targeted towards a narrower subset of people than the other subjects so I wouldn’t recommend it unless you’re sure you enjoy it”*
- *“If you know you want to do Physics in later years or you at least want the option to do so, Physics IA is essential ... however, it is commonly known that the department is not nearly as helpful as that of Earth Sciences or Materials, for example, so be prepared to struggle on your own”*
- *“I found this course badly taught and difficult to follow; self-study is very useful here but difficult to find time for”*

Physiology of Organisms

PRE-REQUIRED KNOWLEDGE

- Having AS or A-Level Biology, or even Physics, is recommended

LAB SCHEDULE

- Michaelmas - every other week, 12-1 and 2-5pm
- Lent - 7/8 weeks, 12-1 and 2-5pm (alternating plants and animals)
- Easter - 1 practical, 12-1 and 2-5pm

TOPIC BREAKDOWN

- Introduction to Physiology
- Hormones, Homeostasis and Equilibria
- The Nervous System
- Muscles and Movement
- Cardiovascular Physiology
- Animal Nutrient Acquisition
- Respiration in Air and Water
- Osmoregulation in Animals
- Energy and Exercise
- Thermoregulation
- Introduction to Plants
- Light and Gas Exchange
- Water Relations
- Transport and Sensing the Environment
- Plant Responses to the Environment
- Microbial Physiology and Effects on Plants
- Comparative Biomechanics
- Sensing the Environment

ASSESSMENT

- 1 written practical paper for 1.5 hours, consisting of 30 MCQs
- 1 theory paper for 3 hours, consisting of 10 SAQs and 2 out of a choice of 6 essays

STUDENT COMMENTS

- "So much more interesting than I expected! If you are curious about it please give it a try, it exceeds expectations and has great lectures/practicals"
- "I loved this course!"

previous combinations

- *Maths A/B, Physics, Chemistry, Materials*
- *Maths A/B, Physics, Chemistry, Earth Sciences*
- *Maths A / Maths Bio, Chemistry, Biology of Cells, Physiology of Organisms*
- *Maths A / Maths Bio, Chemistry, Biology of Cells, Evolution and Behaviour*
- *Maths A / Maths Bio, Chemistry, Earth Sciences, Biology of Cells*
- *Maths A/B, Physics, Chemistry, Biology of Cells*
- *Maths A/B, Physics, Biology of Cells, Evolution and Behaviour*
- *Maths A/B, Chemistry, Materials Science, Biology of Cells*
- *Maths A/B, Chemistry, Earth Sciences, Materials Science*
- *Maths A / Maths Bio, Earth Sciences, Biology of Cells, Evolution and Behaviour*
- *Maths A/B, Physics, Chemistry, Physiology of Organisms*

advice on combinations

Ultimately, you can take pretty much any combination you want – there aren't really any limits (apart from, for example, if you're taking Physics you will have to take Maths A/B alongside it). The most important thing is to choose subjects that you're going to be interested in.

Most students tend to stick to either the 'Phys NatSci' subjects or the 'Bio NatSci' subjects, but as the combinations taken by past students above demonstrate, it is also common to see students go for a true 'natural sciences' experience, taking subjects from both the physical and the biological sides.

One thing to note for those considering taking a combination such as Physics, Chemistry and Biology of Cells (i.e. a mixture of physical and biological subjects), is that while these are great combinations that provide great breadth of study, they are definitely some of the most challenging combinations. This is largely due to a lack of crossover between the subjects. If you'd like to go down this sort of route but find the idea daunting, looking at practical schedules might help you make your decision. Physics, Chemistry and Biology of Cells is one of the most difficult combinations, so if this sounds daunting to you, you might consider swapping Biology of Cells for Evolution and Behaviour, which has fewer practical hours. Alternatively, unless you think there's a real chance that you will continue Physics in later years, you might consider swapping Physics for Earth Sciences, as Physics is a very difficult and time-consuming module.

PART IB

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NB

Two of the available IB subjects, *Mathematical and Computational Biology*, and *Quantitative and Environmental Science*, do not have their own pages in this guide as they are new for 2022-23 and so there is no information on them yet from past students. Additionally, unfortunately I did not find anyone able to fill in the pages for 'Earth Sciences A', 'Ecology, Evolution and Conservation', 'Experimental Psychology', 'Neurobiology' and 'Plant and Microbial Sciences' – if you're reading this, have taken one of these subjects and would be willing to help me with these pages, please drop me an email at jrmr2@cam.ac.uk :)

Biochemistry & Molecular Biology

PRE-REQUIRED KNOWLEDGE

- *Part IA Biology of Cells is essential*
- *A-Level Chemistry (or equivalent) is essential*

LAB SCHEDULE

- *1 lab per week, approximately 12-5, including a 1-hour lunch break (note that it is very common to finish earlier)*
- *Practicals are typically in small groups of 2-30 people*

TOPIC BREAKDOWN

- *Gene Cloning & Manipulation*
- *Nucleic Acid Structure, Protein-Nucleic Acid Interactions & Transcription*
- *Post-transcriptional Control of Gene Expression*
- *Protein Structure, Function & Evolution*
- *Enzyme Catalysis & Protein Engineering*
- *Control of Metabolism*
- *Transduction in Bacteria, Mitochondria & Chloroplasts*
- *Transmembrane Signalling: Molecules & Mechanisms*
- *Control of Eukaryotic Cell Growth*
- *Bacterial Chemotaxis Immunology: the basics*
- *How the Other Three Quarters Lives - How Protists Break the Rules of Biochemistry*
- *Oncogenes, Tumour Suppressor Genes & Cancer*

ASSESSMENT

- *2 essay papers based on the content of the lectures*
- *1 written paper based on practical work conducted throughout the year*

STUDENT COMMENTS

- *"The course was pretty difficult, but it was really well organised and super interesting"*

PROGRESSION

- *If you're not taking IB Cell and Developmental Biology, then this course is essential for Part II Biochemistry (otherwise it is simply recommended)*

Biology of Disease

PRE-REQUIRED KNOWLEDGE

- *IA Biology of Cells and IA Physiology of Organisms recommended but definitely not essential*

LAB SCHEDULE

- *2 practicals per week*
- *Each practical is 2 hours*

TOPIC BREAKDOWN

- *Immunity*
- *Viruses*
- *Bacteria*
- *Parasites*
- *Circulatory diseases*
- *Cancer*

ASSESSMENT

- *3 papers (weighted Paper 1 30%, Paper 2 50%, Paper 3 20%)*
- *Paper 1 (short answer paper): 90 minutes; compulsory and equally weighted questions requiring short written answers*
- *Paper 2 (essay paper): 3 hours; required to write 4 essays; choose 2 from section A and 2 from section B (each section has a choice of four questions)*
- *Paper 3 (practical paper): 3 hours; 5 compulsory and equally weighted questions requiring written answers; includes biological, photographic, diagrammatic and sectioned material, data handling and knowledge of laboratory techniques*

STUDENT COMMENTS

- *Very well-organised course with great lecturers*
- *Information-heavy but really captivating and well-delivered lectures that convinced me to do Part II Pathology, which I enjoyed a lot*
- *Practicals are also really interesting and well-organised with amazing demonstrators*
- *Well-supervised at John's*

PROGRESSION

- *This course is recommended for Part II Pathology*

Cell and Developmental Biology

PRE-REQUIRED KNOWLEDGE

- *IA Biology of Cells is highly recommended (though may not be necessary, as lots of the topics are just covered again in more detail)*

LAB SCHEDULE

- *Generally 3 hours (11-2 or 2-5)*
- *Practicals may be longer/more frequent than last year due to the relaxation of Covid regulations*

TOPIC BREAKDOWN

- *Molecular biology of the cell nucleus*
- *Genes and cell decisions*
- *Genetic systems of prokaryotes*
- *Genome organisation and function*
- *Yeast as model organisms*
- *Genetic systems of chloroplasts and mitochondria*
- *The eukaryotic cytoskeleton*
- *Membrane trafficking*
- *Co-ordination of organelle and cellular function*
- *Signalling*
- *Invertebrate development*
- *Plant development*
- *Vertebrate development*
- *Mammalian development*

ASSESSMENT

- *One 3-hour paper based on lecture material, with four essays chosen, one from each of the three sections and one extra, contributes 50% of grade*
- *One 3-hour paper in two sections: one with two essays based on broad themes, the other with short-answer practical questions, Contributes 50% of grade*

STUDENT COMMENTS

- *"Very molecular, lots of details. I did it for the developmental side of the module, which only came late in Lent. The saving grace of Michaelmas is that most of the lecturers were phenomenal, and made the topics really interesting even for people like me (cell nucleus, gene expression, prokaryotic nucleus (way more interesting than expected!), yeast genetics). Lent is a bit more tedious, I found the Drosophila and C elegans development stuff in Lent not very well taught (although the amount of content is manageable). Easter term development stuff was much more interesting (frog, zebrafish, mice, humans). Overall, I quite enjoyed it even taken without biochemistry, although there is a LOT of detail"*

PROGRESSION

- *This course is recommended for Part II Genetics*
- *If you're not taking IB Biochemistry and Molecular Biology, then this course is essential for Part II Biochemistry (otherwise it is simply recommended)*
- *This course is recommended for Part II Physiology, Development and Neuroscience*

Chemistry A

PRE-REQUIRED KNOWLEDGE

- *Part IA Chemistry is essential*
- *Part IA Maths or IA Maths Bio is essential (the course is not mathematically difficult, but it is mathematically formalised)*
- *Part IA Physics and IA Materials Science are recommended*

LAB SCHEDULE

- *One 2-6 session every week for 6 consecutive weeks each term, alternating between experiments and computing ones*
- *The write-ups are submitted before the next practical session, and usually you will be asked about what you have done in a 5-minute viva with an assessor*

TOPIC BREAKDOWN

- *Introduction to quantum mechanics*
- *Molecular Spectroscopy*
- *Symmetry and Bonding*
- *Molecular energy levels and thermodynamics*
- *Electronic structure and properties of solids*

ASSESSMENT

- *Two 3 hours theory papers based on lecture material, contributes 80% to your overall IB Chemistry A grade - the first one has 2 questions on IQM, 1 on MS, and two on S&B, the second one has 3 questions on MELT, and two on ESPS*
- *Practical write-ups submitted throughout the year, 12 in total, contributing to the remaining 20% of your grade*

STUDENT COMMENTS

- *"The course starts with some very simple assumptions and abstract notions which seemed scarcely related to Chemistry as I knew it before. But as it progressed, it became more and more descriptive of atoms, molecules, bonds, until it finally yielded some very impressive results of bulk materials, such as equilibrium constants and molar entropies. Only at that point did I appreciate the whole structure of the course, not only seeing it as a collection of mathematical tools"*
- *"Don't be frightened when you hear about quantum or maths. By having done maths last year you will be able to handle this course well"*

PROGRESSION

- *This course is essential for Part II Chemistry and ideally must be taken alongside IB Chemistry B in order to be able to take Part II Chemistry (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)*

Chemistry B

PRE-REQUIRED KNOWLEDGE

- *Part IA Chemistry is essential*
- *Part IA Biology of Cells is recommended (this is only useful in Easter term and even then, you approach the topic from the different perspective of chemical biology rather than biochemistry - but familiarity of concepts is comforting)*

LAB SCHEDULE

- *A block of time is set from 1:45-6 on your lab day to complete a practical, although these usually take 2-3 hours*
- *Write-ups of the practicals usually take another 3-4 hours outside of the lab (there are a couple of practicals spread over two weeks and you only have to do one report for)*

TOPIC BREAKDOWN

- *Aromatic and enolate chemistry*
- *Conjugate addition and chirality*
- *Introduction to stereochemistry*
- *Shape and organic reactivity*
- *Structure, bonding, and reactivity of transition metal complexes*
- *Structure, bonding, and the p-block elements*
- *Introduction to chemical biology*

ASSESSMENT

- *Two 3-hour unseen written examinations to test lecture content, consists of 5 questions you must answer all of*
- *Submission of practical write-ups throughout Michaelmas and Lent terms*

STUDENT COMMENTS

- *"Apart from one organic chemistry course where they just throw reactions at you the content was really interesting"*
- *"This is a great course"*

PROGRESSION

- *This course is essential for Part II Chemistry*
- *In order to have access to every option within Part II Chemistry, you will need to take Chemistry A alongside Chemistry B - however, there is still a route into third year Chemistry for those who have only taken Chemistry B, where you sit a paper specific to this route (i.e. choice within the course will be reduced)*

Earth Sciences B

PRE-REQUIRED KNOWLEDGE

- *Part 1A Earth Sciences is essential*

LAB SCHEDULE

- *Three two-hours sessions in which you will mainly be looking at minerals and rocks in thin sections - these are specifically connected to the lecture material and are commonly supervised by the lecturers themselves*
- *Some map practicals will be scattered throughout the year - these look complicated and you will need to revise a bit your toolkit from last year*

TOPIC BREAKDOWN

- *Crystallography & Optical Mineralogy*
- *Principles of Mineral Behaviour*
- *Igneous Petrology and Volcanology*
- *Origin and Evolution of Meteorites and the Terrestrial Planets*
- *Magmatic Settings*
- *Global Structural Seismology*
- *Metamorphic Petrology*
- *Himalayan Lectures (used as revision for all the other lecture blocks)*

ASSESSMENT

- *Two 3-hour theory papers based on lecture material, contributes 70% to the final mark - both consist of a series of questions from which you need to choose 4 that suit you best. Usually, the first exam contains more calculation-oriented questions, while the second one consists of essays only*
- *Practical marks contribute 30% to the final grade, but the way they work changed a few times in the last years. During peak COVID years, there were 9 assessed practicals spread across the year. Before, there were two practical exams instead, one focusing on rock and thin section identification, one on maps*

STUDENT COMMENTS

- *"Michaelmas was interesting and well taught, especially the topic on meteorites and the early solar system. Lent was also interesting, especially the magmatic settings topic. Easter was also very interesting but slightly less well taught, the Himalayas lectures weren't the best, but it was a different lecturer to normal, and the usual one should be back this year. Labs are generally very good"*
- *"If you loved thin sections, volcanic and metamorphic rocks, geological dating, and the universe question, then this course is for you"*
- *"One of the smallest IB cohorts, and as you go to the lab 3 times per week you will start to feel like a family (students, demonstrators and lecturers included)"*
- *"It is fairly interesting and there are numerous ties between the lecture blocks. I would advise adding the real-life examples that you will get across in the practicals in your lecture notes"*

PROGRESSION

- *It is recommended to have taken both IB Earth Sciences A and Earth Sciences B in order to take Part II Earth Sciences, but it is possible to take this Part II course having done only one of the two IB courses*

Evolution and Animal Diversity

PRE-REQUIRED KNOWLEDGE

- 1A Evolution and Behaviour (very helpful but not necessary)
- Basic R knowledge (usually from 1A Mathematical Biology, but easy to pick up)

LAB SCHEDULE

- One 12-5 lab every other week, there is a lunch break during the session and for most practicals you will be able to leave early

TOPIC BREAKDOWN

- Animal behaviour (foraging, predators and prey, modelling)
- Evolutionary genetics (population genetics, quantitative genetics, evolutionary genomics)
- Phylogenies and macroevolution
- Vertebrate evolutionary biology
- Insect physiology, evolution and neurobiology

ASSESSMENT

- Practicals are assessed in the form of write ups throughout the year and count for 20% of the final grade
- One 3 hour written paper based on theory, consisting of 9 essay questions, divided into 4 sections representing each section of the course - you will have to write 4 essays from at least 3 sessions (40% of final grade)
- One 3 hour written paper based on theory, consisting of 6 questions from any part of the course, of which you choose 5 - some questions may have sub-questions (40% of final grade)

STUDENT COMMENTS

- "Is an overall great course! Most of Michaelmas is focused on animal behaviour. The first 2 lecture series are amazing with really fun theory but the 3rd lecture series is slightly tedious when it came to modelling (loads of details that you actually don't really need to know, boring lecturer, repetitive examples). Lent is more theoretical evolutionary biology with a really good lecture series on insect biology and a meh series on vertebrate biology. Easter has a series on insect neurobiology which sounds intimidating but it's actually not too much content and the lecturer is very clear. The practicals are very fun. In general I would definitely recommend this course, especially for the animal behaviour"

PROGRESSION

- This course is not specifically required for any Part II subject

History and Philosophy of Science

PRE-REQUIRED KNOWLEDGE

- None

LAB SCHEDULE

- None

TOPIC BREAKDOWN

- *Natural Philosophy: Discoveries; The Body (Medicine and Sex); Occult Philosophies (Astrology, Alchemy and Magic); Renaissance of Anatomy, Francis Bacon; Mechanics, War, Religion and Philosophy; Medical Worlds (Latin America); The Royal Society and the World; God, Newton and Newtonianism; Science, Reason, Enlightenment and Religion*
- *History of Science and Medicine: Science for Empire and Nation; A Medical Revolution; Origin of Species; Industry, Universities and the Science of Energy; Colonial Science; Microbe Hunting; Genetics, Eugenics and Evolution; Making Modern Physics; Science and War; Race, Disease and Molecules; Sexual Chemistry; Postcolonial Science and Medicine*
- *What is science / scientific methods: Induction; Popper (falsificationism); Lakatos; Kuhn (normal science, paradigms, revolutions, incommensurability, method wars); Feyerabend; Evidence and inference*
- *Philosophy of Science in Practice: Who should we fund; What should we allow; What should we do about uncertainty*
- *Philosophy of Physics*
- *Philosophy of Biology*
- *Can Machines Think: The problem of other minds; Materialism and the mind; Biological minds*
- *Philosophy of Social Science*

ASSESSMENT

- *Two 3 hour papers, 1 for History of Science and 1 for Philosophy of Science*

STUDENT COMMENTS

- *"No labs!! Really interesting content and helps you to develop a wider range of skills to other options, as the focus is on essay writing and arguing for a point of view. Challenges your understanding of how science operates as a practice. Relatively easy to get a good mark, and less contact hours than other options"*

PROGRESSION

- *Part II History and Philosophy of Science doesn't assume knowledge of IB History and Philosophy of Science, however, 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'*

Materials Science

PRE-REQUIRED KNOWLEDGE

- Part IA materials strongly preferred - it is possible to take IB materials without IA, but it is an order of magnitude more difficult to catch up
- Otherwise, a strong background in chemistry or physics is beneficial but not integral - bio natscis can be very successful at IB materials as well

LAB SCHEDULE

- One practical per week, either Mon 9-11.30, Tues 2-4.30, Wed 9-11.30 or Wed 2-4.30
- Typically takes less than allotted time in timetable to complete, lab write ups reasonably informal and quick to do (unlike eg. chemistry)
- Practicals in Michaelmas and Lent Terms only

TOPIC BREAKDOWN

- Metals and Alloys
- Mechanics of Materials and Structures
- Non-Metallic Materials
- Structure and Characterisation
- Materials Chemistry
- Electrical Properties of Materials

Further details available [here](#)

ASSESSMENT

- Two 3 hour papers contributing 80% to the overall IB materials science grade
- Remaining 20% from continuously-assessed work throughout the year, including a python project and practical write-ups

STUDENT COMMENTS

- "Very friendly and caring department, willing to be flexible and make accommodations wherever is reasonable, with a lovely community of lecturers and people who value having a work-life balance"
- "Jess and Rob (who run the undergrad courses) are wonderfully dedicated and caring people who want to make a real effort to make a great course and are very receptive to feedback"
- "Electrical Properties of Materials in Easter Term is incredibly similar to the Chemistry A course running in the same term - this can make your life a lot easier while trying to revise"
- "Gets a lot more interesting than IA materials (where they are having to try and teach all the basics as it is a new subject for the vast majority of people)- some really fun science!"

PROGRESSION

- This course is essential for Part II Materials Science

Mathematics

PRE-REQUIRED KNOWLEDGE

- 1A Maths A/B (Maths B is very useful, but not technically required)

LAB SCHEDULE

- Computational work occurs over Christmas/Easter - usually takes a few days, and high marks are easy to attain by simply completing the project

TOPIC BREAKDOWN

Full details
available [here](#)

- Vector Calculus
- Partial Differential Equations
- Green's functions
- Fourier Transform
- Matrices
- Analysis
- ODEs
- Sturm-Liouville Theory
- Calculus of Variations
- Laplace/Poisson's equations
- Tensors
- Complex analysis
- Normal modes
- Group Theory

ASSESSMENT

- Two 3 hour written papers
- Practical mark based on lab work and experimental write-up (almost everyone gets >90%)
- (see handbook linked above for details of mark breakdown)

STUDENT COMMENTS

- "The course is amazing if you do physics, but not terribly useful otherwise. The maths almost always comes just before the relevant topic is introduced in Physics A/B, so these courses work well together. Some aspects of the maths are also useful for Chemistry A. Lecture notes are always good and comprehensive, and the lecturing is clear and helpful"
- "Maths is hard, don't do it unless you're confident or just really really want to"

PROGRESSION

- This course is highly recommended for Part II Physics (and taking the two IB Physics courses without IB Maths is very difficult)

Pharmacology

PRE-REQUIRED KNOWLEDGE

- *Having one of Part IA Biology of Cells, Chemistry or Physiology of Organisms is recommended*
- *A Level Biology and/or Chemistry is recommended*

LAB SCHEDULE

- *6 practicals (2-5pm) in Michaelmas term, 5 practicals (2-5pm) in Lent term replaced by a mini-project*
- *Lectures on Pharmacodynamics and Pharmacokinetics complement the practical courses*

TOPIC BREAKDOWN

- *Structure and Function of Receptors*
- *Synaptic Pharmacology*
- *Antimicrobial, Antiviral & Anticancer Drugs*
- *Pharmacokinetics, Drug Metabolism and General Anaesthetics*
- *Central Nervous System*
- *Endocrinology and Diabetes*
- *Cardiovascular and Renal Pharmacology*
- *Inflammation, Pain & Immunopharmacology*
- *Drug Discovery*

ASSESSMENT

- *One written "essay" paper*
- *One written "practical" paper*
- *Presentation of a poster with data gathered in a mini-project*

STUDENT COMMENTS

- *"I found this course interesting, although there was more Physiology and less Chemistry than I initially expected. I took this without doing Physiology in IA so it's definitely possible"*

PROGRESSION

- *This course is recommended for Part II Pharmacology*

Physics A

PRE-REQUIRED KNOWLEDGE

- *IA Physics*
- *IA Maths A/B is recommended (note that Physics A is less mathematical, so having Maths B is not much more helpful)*
- *IA Materials can be useful for the 'Condensed Matter' topic, but not essential*

LAB SCHEDULE

- *1 lab day per week if also taking Physics B; one per 2 weeks if only Physics A*
- *Lab day is 10am-6pm with a lunch break*
- *Experimental write-up to be undertaken in Christmas holiday (2-3 days of work)*
- *Computational exercised in Christmas/Easter holidays (2-3 days of work total)*

TOPIC BREAKDOWN

- *Experimental Methods: systems, errors, experimental procedure...*
- *Oscillations, Waves, and Optics: oscillations and waves in 1D and 3D, Fourier transforms and optics, interference*
- *Quantum Physics: Wave quantum mechanics, Operator Methods, Time dependency...*
- *Condensed Matter Physics: Photons & electrons, semiconductors*

ASSESSMENT

- *Two 3 hour written papers*
- *Practical mark based on lab work and experimental write-up (almost everyone gets >90%)*
- *Computational work mark*
- *(see Cavendish Physics handbook for details of mark breakdown)*

STUDENT COMMENTS

- *"A really enjoyable course, which focuses more on physical understanding and less on mathematical abstraction (compared to Physics B). Very fast-paced, so try not to fall behind as it's really hard to catch up"*

PROGRESSION

- *This course is essential for Part II Physics and must be taken alongside IB Physics B*
- *This course is recommended for Part II Astrophysics, alongside IB Physics B and IB Mathematics*

Physics B

PRE-REQUIRED KNOWLEDGE

- *IA Physics*
- *IA Maths A/B (Maths B helps but is not essential)*

LAB SCHEDULE

- *1 lab day per week if also taking Physics A; one per 2 weeks if only Physics B*
- *Lab day is 10am-6pm with a lunch break*
- *Experimental write-up to be undertaken in Christmas holiday (2-3 days of work)*
- *Computational exercises in Christmas/Easter holidays (2-3 days of work total)*

TOPIC BREAKDOWN

- *Electromagnetism: Maxwell's equations, waves, materials...*
- *Classical Dynamics: Reference frames & Fictitious forces, orbits, rotational dynamics, Lagrangian dynamics, normal modes, elasticity, fluid dynamics*
- *Thermal Physics: Heat engines, Laws of Thermodynamics, Phase changes, Analytical Thermodynamics, Statistical Mechanics, Kinetic gas theory*

ASSESSMENT

- *Two 3 hour written papers*
- *Practical mark based on lab work and experimental write-up (almost everyone gets >90%)*
- *Computational work mark*
- *(see Cavendish Physics handbook for details of mark breakdown)*

STUDENT COMMENTS

- *"A hard but enjoyable course. Builds the 3 pillars of classical physics, so with an understanding of this course you can really start to understand modern physics. Be prepared for some variable lecture quality..."*

PROGRESSION

- *This course is essential for Part II Physics and must be taken alongside IB Physics A*
- *This course is recommended for Part II Astrophysics, alongside IB Physics A and IB Mathematics*

Physiology

PRE-REQUIRED KNOWLEDGE

- *IA Physiology of Organisms (especially Michaelmas term topics)*

LAB SCHEDULE

- *One 2-5pm session approximately once a week, one or two weeks per term would have no practicals that week*
- *Note that most practicals don't take that long, you can leave as soon as you have finished*
- *Many of the histology practicals can be done online, although some histology practicals in Lent include in-person dissections*

TOPIC BREAKDOWN

- *Organ systems (cardiovascular, endocrinology, respiration, renal, blood and lymph, digestive system)*
- *Reproductive physiology (sex determination, pregnancy, placenta, neonatal physiology)*
- *Extreme physiology (high altitude, exercise physiology, extreme heat and extreme cold, microgravity)*

ASSESSMENT

- *One 3-hour exam on theory, consisting of 1 hour of multiple-choice questions taken from any aspect of the lecture component of the course (20% of final grade), and 2 hours for 3 essays from a choice of no fewer than 6 topics (50% of final grade)*
- *One 1 hour 40 mins exam on the practical component, comprising of multiple choice questions taken from the histology and practical components of the course, which includes calculation questions (30% of final grade)*

STUDENT COMMENTS

- *"Exceeded my expectations! Michaelmas was focused on different physiological systems e.g. cardiovascular, respiratory, renal, etc. Most of the lecturers are really amazing and engaging in person. Lent is focused on reproductive biology with more of a focus on different animals (while Michaelmas is very human-centric), which was very well taught. In Lent there is also digestive system which was really heavy and I didn't love that. Easter term physiology was a massive highlight and was focused on extreme physiology (extreme hot/cold/altitude/outer space). Extremely good lecturers for that term and not too much content which made exam term more bearable!"*

PROGRESSION

- *This course is recommended for Part II Physiology, Development and Neuroscience*

previous combinations

- Maths, Physics A, Physics B
- Chemistry A, Chemistry B, Earth Sciences B
- Chemistry B, Physics A, Physics B
- Cell & Developmental Biology, Evolution & Animal Diversity, Plant & Microbial Sciences
- Biochemistry & Molecular Biology, Biology of Disease, Cell & Developmental Biology
- Biochemistry & Molecular Biology, Chemistry B, Pharmacology
- Biochemistry & Molecular Biology, Cell & Developmental Biology, Chemistry B
- Biochemistry & Molecular Biology, Chemistry A, Chemistry B
- Chemistry B, Neurobiology, Pharmacology
- Cell & Developmental Biology, Evolution & Animal Diversity, Physiology
- Chemistry A, Chemistry B, Materials Science
- Earth Sciences A, Earth Sciences B, History & Philosophy of Science
- Ecology, Evolution & Conservation, Evolution & Animal Diversity, Plant & Microbial Sciences
- Biology of Disease, Cell & Developmental Biology, History & Philosophy of Science

advice on combinations

At IB, the main limits on subject combinations (apart from the obvious such as you need to take both Physics courses in order to study it in 3rd year) come from timetabling issues – you cannot take more than one subject from each of the following groups:

Group	Subjects
A	Earth Sciences B; Physics B; Mathematical and Computational Biology
B	Biochemistry and Molecular Biology; Earth Sciences A
C	Evolution and Animal Diversity; Maths; Pharmacology; Quantitative and Environmental Science
D	Ecology, Evolution and Conservation; Biology of Disease; Physics A
E	Chemistry B; Physiology
F	Materials Science; Cell and Developmental Biology
G	Experimental Psychology; Plant and Microbial Sciences
H	Chemistry A; Neurobiology
I	History and Philosophy of Science

It is worth taking a look at the Part II subject information to see what are the requirements for the 3rd year courses you think you might be interested in at this stage: <https://www.natsci-tripos.cam.ac.uk/subject-information/part2>