The SciSoc Guide to NST IA

Updated Summer 2024

CAMBRIDGE UNIVERSITY SCIENTIFIC SOCIETY

Congratulations on getting here! You must be very excited to explore what Cambridge has to offer – it will definitely be great! SciSoc is the largest and most active science society at the University of Cambridge. We organise talks on a wide range of scientific subjects and many social events throughout the year. We can't wait to get you involved!

To help you get started with your studies, we have put together this booklet with advice on your subjects from our own experiences and those of NatSci students who have just completed first year. Of course, everyone is different so not all of these tips may apply to you, but we hope some of the advice will be useful throughout your first year.

Many thanks to Hamish Trowell who started this guide in 2017, and the 2018-2024 SciSoc committees who reviewed the guide and added to his advice!

To find out more about SciSoc, check out our website: http://scisoc.com/

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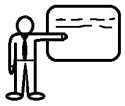
Mathematics A/B



Lectures:

Most of the lectures provide a lecture booklet with notes inside. This means it is easier to make fewer notes during the lectures so you can spend more time concentrating on the lecture itself. Try to prioritise understanding concepts as it is not possible to memorise all information thrown your way. A copy of the notes annotated by the lecturer will be uploaded onto Moodle afterwards (though some lecturers may take a few days to upload them). Reading over previous lecture notes and making sure you understand them is important as lectures usually build on each other.

For course A, there is no handout for Lent term lectures, but a copy of the notes are still available. Likewise for Easter term, but instead of notes, lecture slides are provided.

Supervisions:

At the start of each term, a booklet of questions is given which contains the supervision questions to accompany the lectures. Your supervisor decides which questions you do each week. The length of the questions varies quite a bit so some weeks you might do a few longer answer questions and other weeks you might do more shorter answer questions. Supervision time is mostly taken up with going through the corrections to your answers.

Practicals:

You will have four sessions, each assessed, each term (Michaelmas and Lent) on Scientific Computing starting from the middle of Michaelmas and Lent (week 3-6). The coding language used is Python and you will mainly work with Matplotlib and NumPy. Make the most out of the practical sessions when people will be around to help you - it is possible to do the majority of each assessed exercise if you work fast. The course handbook and lab notebooks should have everything you need to know to complete the task. Ask a friend or demonstrator if you get stuck and try not to spend forever on each task - just make sure you do everything required (e.g. axis labels, suitable scale) to score. Look back over and remember the coding you have done in previous weeks - you don't want to restart learning all the code every session!

Revision:

The best way to revise maths is to practise doing supervision and past paper questions. Don't worry about doing the papers within the time until closer to the exam. You may not be able to answer some questions, so to prevent spending hours on a question, ask your friends/supervisor for help. It is useful to write down formulae that you need to learn on a few pages as a reference. Use the supervisor's comments/answers to past paper questions to guide your revision. You may be asked to show a shorter proof from the lecture notes, but these questions are rare and they don't carry a lot of marks. Additionally, many people say it is easier to practise deriving a formula very quickly instead of memorising it. Again, understanding is more important than memorising and will take far less time.

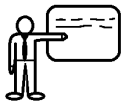
Exams:

In the exam there are two sections - A and B. Section A has 10 short answer questions and only your final answers are marked; don't worry about showing your method. If you can't do a question, leave it and move on as each question is worth very little of your final mark. (Just for your reference, the whole of Section A is worth the same number of marks as one question from Section B). Section B has 10 questions, 2 of which are starred (*) and require knowledge from the Maths B course, although they can sometimes be easier than other questions if you have a good understanding. The rest relate to the Maths A course only. From these 10 you choose 5 questions. Technically, you are able to do more than 5 but only the 5 highest scoring questions will be taken, and as the exam is so time-pressured it's very unlikely you'll want to address more than 5. You will need to learn how to choose the questions that you will score most highly.

Useful resources:

- ➔ Notes on partial derivatives, multiple integrals, vector calculus, surface integrals - http://tutorial.math.lamar.edu/Classes/CalcIII/CalcIII.aspx
- ➔ More qualitative descriptions of various concepts (may help to understand vector calculus) - http://mathinsight.org
- ➔ Useful for asking specific questions - http://math.stackexchange.com
- ➔ Essence of linear algebra: interesting videos giving a qualitative view of the topic - Essence of Linear Algebra - 3blue1brown
- ➔ More information on differentiating under the integral sign - http://www.math.uconn.edu/~kconrad/blurbs/analysis/diffunderint.pdf
- ➔ Numerical answers to past exam papers: https://www.robinson.cam.ac.uk/iar1/teaching/

Mathematical Biology



Lectures:

This module differs from Maths A/B mostly in the amount of applied maths that is used; Maths A/B has a stronger focus on pure maths, while Math Bio provides a great foundation for the common mathematical tools employed in biological research. The choice between Maths A/B and Math Bio depends on the courses you intend to take in the future; this is a discussion worth having with your DOS.

The lecture notes are very descriptive and understandable although a lot of people still like to take their own notes in the lectures. It is worth not missing lectures though as there will be lots of examples in the lectures that aren't in the notes. These examples are often more useful than the notes to work out how to answer supervision questions- you can refer back to them and apply the same or at the very least a modified approach. Mainly matrices, statistics and differential equations will be covered throughout the course, along with various applications of these techniques for biological models.

The lecture series titles are listed below:

Michaelmas:

- **Probability**
- **Linear Algebra**
- **Introduction to Statistics**
- **Linear Models I**
- **Linear Models II**
- **Generalised Linear Models**

Lent:

- **Modelling Biological Systems using Differential Equations**
- **Solving Systems of Simultaneous Differential Equations**
- **Dynamic Models for Complex Biological Systems**

Easter:

- **Introduction to Bioinformatics**
- **Modelling Reaction Kinetics**
- **Evolutionary Modelling**

Supervisions:

Problem sheets will be provided for each lecture block. Your supervisor will tell you the questions to complete each week which will be covered during the supervision. An example sheet can take up to 2 hours, but are usually shorter than that. Your supervisor will also answer any queries you might have or even give critical thinking questions for you to ponder on.

Practicals:

Once every week there is a computing lab lasting an hour. Here you will learn how to code R, a language that's extremely useful and widely applied in academia for statistical analysis. The main reason to attend the lab sessions is to get help from demonstrators. Sometimes R won't run as you'd like, and so it is useful to get an extra pair of eyes reading your code. That being said, most practical leaders (who are usually the lecturers of that block) upload yellow answer sheets to the practicals on Moodle the day afterwards so you can check your own answers later.

You have 3 assessed practicals altogether. One is done at the end of Michaelmas, another at the end of Lent and a third at the start of Easter term. The first two are both worth 8% and the final one is worth 4%. Overall, the labs in Michaelmas are fairly straightforward and grow progressively more complex during Lent and Easter.

Revision:

It can be worth going back over supervision material and checking understanding that way. The best way to revise for Mathematical Biology is to do past papers. Note that since the course was only recently introduced (2017/18 was the first year group to do it), past papers from before then will have some questions that aren't applicable to you, and some newer content will be missing (the topics from Easter weren't on the old course). There's a useful table uploaded together with the older questions that indicates which questions in each past paper are still in the syllabus and which aren't. The most important thing to learn during the academic year is to figure out what exactly questions are asking for.

Exams:

The exam is 3 hours long and there are 10 questions, with equal weighting, of which you must answer 8. There are 5 sections in total- one for each half term- with 2 questions per section. You must answer one question from each section and then choose which sections

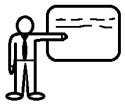
to answer 2 from. Keep this in mind when reviewing content -- focus most on the half-terms that you feel most confident in (as these will be the sections you answer 2 questions in), but try not to neglect or completely ignore any half-term.

Also, familiarise yourself with the formula booklet, as many useful formulae aren't actually in it - it's available on Moodle.

Useful resources:

- ➔ Video tutorials for matrices- https://www.youtube.com/watch?v=fNk_zzaMoSs
- ➔ Video tutorials for Taylor series- https://www.youtube.com/watch?v=3d6DsjIBzJ4&feature=youtu.be
- ➔ Video tutorials for calculus review: https://www.youtube.com/playlist?list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr
- ➔ Basic algebra calculator- https://www.wolframalpha.com/
- ➔ Eigenvector, matrices calculator- https://www.symbolab.com/
- ➔ Linear phase portraits and classification- https://mathlets.org/mathlets/linear-phase-portraits-matrix-entry/
- ➔ Phase plane plotter- https://aeb019.hosted.uark.edu/pplane.html

Biology of Cells



Lectures:

Most of the notes needed for the lectures are in the lecture handout, although you may want to annotate them as you go through. The lectures are very information-dense so reading the lecture notes ahead of time is very useful. Ask the lecturer any questions you have at the end of the lecture or in an email - they will have useful information for essays (they will also be marking your exams so including what they feel is important information will help your essay stand out). Re-reading the lecture notes will stop you forgetting everything you learnt earlier, saving time on revision. The most important thing is to be able to explain the big ideas (eg. how proteins are delivered to different organelles or why amplification is needed in intracellular signalling).

The lecture series titles are listed below:

Michaelmas:

- **The Living Cell**
- **Macromolecules in the Cell**
- **Membranes**
- **Chemistry of Life I**
- **Chemistry of Life II**
- **Chemistry of Life III**

Lent:

- **Hunting the Gene**
- **Genes in Action**
- **The Genetic Revolution**
- **Cell Proliferation**

Easter:

- **Cell Signalling**
- **Development**

Just to note, the first lecture series is very facts-based and jumps between different topics very quickly, skipping lots of detail for later lectures. As such, whilst it may serve as a brief revision for those who have done Biology A-level, it is not a great introduction for non-biologists who may find it near impossible to keep up. Just read the lecture notes slowly in your own time and realise that they serve mostly as an introduction for later lectures.

Supervisions:

Supervision work ranges from writing essays, answering short answer questions (SAQs) and doing practical paper questions. Your essays for supervisions may take a few hours to research, plan and write (especially if you're a good procrastinator!). Don't panic though - you will be surprised how much you can write for an essay in around 40 minutes in the exam with practice. Finally, make the most out of your supervisions by reviewing your essays, understanding concepts, and getting new ideas - don't be afraid to ask questions! Further researching topics of interest by reading research papers can also help supplement your learning and improve essay writing.

Practicals:

There is one Biology of Cells practical per week. Practicals are marked by a practical exam paper at the end of the year, with questions relating to the method/theory of the experiments. Enjoy the practicals as they are interesting and can be quite fun, but try to stay focused on the tasks. Read the practical notes before the practical. Ask your partner/demonstrator questions and add notes to your practical sheets so that you know why the experiment is designed the way it is - the details are quite important. You will also have practicals to do online so some weeks you won't have to go to labs. Remember that you will still be asked questions on these in the exam.

Quite a lot of the biology practicals require you to be able to do calculations. Use the calculation cards at the front of your practical folder as these have all the formulae you'll need to remember for the exam.

Revision:

The theory paper has a short answer section on the whole course and 3 essay questions that you choose. Therefore, you need to know a bit about the whole course and lots about a select few lecture series (be careful - not all lecture series may have an essay question). Knowing a few examples in detail that can be applied to different ideas will reduce the amount you have to learn. Learn to draw simple diagrams quickly to illustrate your points (e.g. endocytosis or the replication fork) as the exams are time-pressured. As there is more than one way to answer essay questions, going over them with others will help get new ideas. Reading textbooks can help if you don't understand a topic, but don't get flooded by facts - learn the big ideas. Space your revision out over a long time and keep revisiting

lecture series you plan to use for essays to remember more details. Repetition is key! Essay plans are a good way to revise without having to write a whole essay. Practice writing timed essays as you get closer to exams, and remember to draw information from different lecture series where possible (this is good preparation for integrative essays in IB). By focussing on examples that can be applied to multiple topics you can reduce the amount of information you need to learn.

Don't forget to revise the practical papers too. Read/summarise the practical handouts, making sure you understand everything. The more past papers you do, the better marks you will get. It may be easier to go through past papers in a group to compare answers.

Exams:

All biology papers (BOC, POO, E&B) are in-person and type-written via the Inspera platform as of 2023/24.

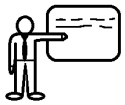
You have two 3 hour exams for Biology of Cells. The theory paper (66% of the grade) has short answer questions on the whole course and three essay questions for you to choose. The short answer questions can usually be answered using a diagram with a little bit of writing and should only take a few minutes each. The essay questions will take around 40 minutes each. Plan your essays before you start writing so you can include all the important ideas first (you may not have time to write everything you know). Try to show some independent thinking by drawing ideas from different lecture series together. Knowing a few examples from your own reading can help your essays stand out as well but is not required for a good mark.

The practical paper (33% of the grade) has 9 questions, each one on a different practical. Answer questions you know how to do first to boost your confidence and to pick up as many marks as you can quickly. Keep an eye on the clock and move on if a question is taking too long.

Useful resources:

- ➔ Everything you need to know (and a whole lot more) - *Molecular Biology of the Cell* (Alberts et al, latest edition not necessary)
- ➔ Consult the *NST IA Biology of Cells Course Handbook* as a reference for what you need to know.

Chemistry



Lectures:

Chemistry is a very popular choice with both Biological and Physical Natural Sciences students. First year covers physical, organic, and inorganic chemistry, setting the foundation for second year if you decide to pursue either organic or physical (or both). The majority of the notes are present in the lecture booklets and the annotations missing are filled in during the lecture. Skimming the notes ahead of a lecture is good preparation and try to make sure you understand the previous lecture before the next one otherwise it is easy to become quickly confused. Lecturers are happy to answer questions at the end of the lecture. There are 3 chemistry lectures a week.

The lecture series titles and a brief description of each are listed below:

Michaelmas:

- **The Shapes and Structures of Molecules Part 1:** Covers the analysis of molecules and their structures using methods of proton NMR, carbon NMR and infrared spectroscopy and mass spectroscopy.
- **The Shapes and Structures of Molecules Part 2:** Covers the atomic and molecular orbitals to molecular shape and interactions between them. Diagrams are a good way to explain these concepts in the exam.
- **Reactions and Mechanisms in Organic Chemistry Part 1:** Covers examples of reaction mechanisms and the theory behind why and how these happen.

Lent:

- **Reactions and Mechanisms in Organic Chemistry Part 2:** Covers more complex reaction mechanisms. It is often possible to work out mechanism steps from the theory taught in lectures and get good marks but it's also a good idea to rote learn the mechanisms given in the examples and the notes for the exam.
- **Kinetics of Chemical Reactions:** Covers reaction kinetics and after doing the supervision questions the methods should be relatively straightforward to apply to exam questions.
- **Energetics and Equilibria:** Covers spontaneous and nonspontaneous reactions, and the second law of thermodynamics in detail. There are several equations and derivations to learn so making a list as you go through the lectures is a good approach.

Easter:

- **Inorganic and Materials Chemistry:** Covers several examples of a few concepts (e.g. Z_{eff}, d/f-block contraction, relativistic effects) and is a very qualitative approach. When answering questions for supervisions, the structure of your answers is important; try to give a definition (e.g. of bond energies), diagram or graph (e.g. of hard/soft bonds), main trend/reason for the trend, anomalies/reason for anomalies. Try not to write long answers as you won't have time in the exam for it - diagrams are usually the best way to condense as much information into your answers quickly.

Supervisions:

At the back of the lecture booklets, there are several questions. Each week your supervisor will select the questions to be completed. Answer these as well as you can as many of them are very similar to exam questions so it's very good practice. The supervisions will most likely be based on going through the corrections to these questions. The answers to these questions are often not released so make sure you understand your supervisor's comments.

Practicals:

There is one chemistry practical every other week. Reading up on the practical before is a good way to speed up completing the practical on the day. The write-up for each practical will be given a grade: Very Good (VG), Good (G), Pass (P) and Fail (F). Generally everyone gets a VG grade as long as you follow the guides given for the write-up. Don't worry too much about the marks as the practicals contribute only 20% to your final mark, instead focus on building your skills in the lab. Ask your demonstrator if you aren't sure about anything or if you don't know why the method requires certain steps. Remember to sign the risk assessment or you will lose all marks for that practical!. All practicals must be written up and handed in on the day.

Revision:

Past papers are the best practice for the chemistry exam. Model answers are available on Moodle, though the answers are not perfect and contain some mistakes. Remember there may be more than one possible answer for a question so don't be discouraged if your answers are different. Practice doing timed papers close to the exam. Clayden's Organic Chemistry textbook has practice questions at the end of chapters which may be useful for the Reactions and Mechanisms course. There is also a solutions manual available - try the

library. Also, note that you have to memorise NMR shifts, IR wavenumbers and pKa values as they will not be provided, so it is good to practice active recall and spaced repetition on those when doing past papers or supervision questions.

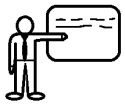
Exams:

There is one exam at the end which is 3 hours long, counting for 80% of your final mark. There are 6 questions - one from each course. Make sure you manage your time carefully in the exam as there is strong time pressure. Answer questions you are most comfortable with first to build confidence. Set a time limit for questions (around 25 minutes) and move onto the next question when your time is up. At the end you can always come back to questions you've left. It's good practice to write down your thought process if you do not know how to answer a question. Often, giving incomplete answers can grab you a reasonable number of marks. This is particularly true for the Reactions and Mechanisms course, where even if your answer is wrong, you may pick up marks for showing knowledge of the mechanisms/importance of pKa values, etc.

Useful resources:

- ➔ Software that gives predictions of NMR and IR spectra for any molecule:
  - http://www.ch.cam.ac.uk/computing/software/chemdraw-and-chemoffice
  - https://www.nmrdb.org/
- ➔ Search by structure - https://www.chemspider.com/StructureSearch.aspx
- ➔ Extra practice questions for Reaction and Mechanisms in Organic Chemistry- *Organic Chemistry* (Clayden et al)
- ➔ Useful textbook for 1A chemistry - *Chemical Structure and Reactivity* (Keeler, Wothers) (also look at their online resources - some cool interactive visualisations and plots)

Earth Sciences



Lectures:

Earth Sciences is often treated as 'the third option' to fill in your choices, but many enjoy the course so much that they choose to abandon their previous plans and continue Earth Sciences in later years. The course itself covers a very wide range of subjects, including volcanics, palaeobiology, climate, sedimentary processes, the geological history of Britain and 'Exoplanet Sciences'. It prepares keen Earth Scientists with a wide knowledge base to grow from, while supplying interested students with a solid grounding in an interesting field. By the end of IA Earth Sciences, you will be able to look at rocks and deduce their geological histories, to notice and describe fossils in the stone of your college and to realise the continental collisions that happened beneath your very feet: hopefully you will be a little more in tune with the inorganic natural world around you, and maybe even the worlds above.

The lecturers are often very information-dense and can move fairly quickly, leaving you a little confused at the end of the hour. Lecture notes are found online and vary between reading like a textbook and having only diagrams. They keep you on your toes for sure. On the whole though, they are well-detailed in the important concepts and often contain references to extra material (which are helpful for essay plans and general understanding). Reading through notes after each lecture is a good idea, as it is for every subject, and make sure to bring up any points of confusion with your supervisors.

The lecture series titles are listed below:

Michaelmas:

- **Physical Properties of Planet Earth**
- **Geology beyond the Solar System**
- **Earth's Climate System**
- **What's the Earth Made Of? An Introduction to Rocks and Minerals**

Lent:

- **From Minerals to Rocks: How the Crust Works**
- **Palaeobiology**
- **Sedimentary Processes and Products**
- **Vertebrae Palaeontology and Evolution**
- **Arran and the Geological Jigsaw**

Easter:

- **Britain's Geology: Solving the Jigsaw**
- **Planet Earth: the Bigger Picture**

Supervisions:

Supervision work is varied: essays, short answer questions, rock and fossil identification and description, and map exercises. Essays and short answer questions will look to cover recently lectured material to check understanding of concepts and to prepare for the written theory exam. Rock and fossil identification and description will prepare you for the practical exam and help put some theoretical knowledge into a more tangible context. Map exercises similarly prepare for the practical exam and can help put theoretical knowledge into a wider context. In the supervisions themselves, you will often simply go over your work, some other exercises (e.g. more maps or fossils) and any difficult topics in the lectures.

Practicals:

The practicals are not assessed but it is worth staying there the whole time (you can leave when you want) and making sure you understand things as there is a practical exam at the end of the year. If you cannot come to your assigned slot for whatever reason, you may turn up to another one, but try to stick to your slot. Do not be scared if you find the first few weeks very confusing - there is a lot of new vocabulary and techniques to get used to, and you will definitely get more confident throughout the year. Ask the demonstrators if you do not understand anything! Many of them are PhD students or younger and so sympathise with whatever confusion you might be feeling. Practicals involving things like maps which require physical paper to write on will have printed copies of those subsections available in the lab for use.

There is also a field trip. The Arran field trip was an amazing experience. Follow your demonstrators closely and pay attention to how they provide an interpretation of and insight into the various things you will see. As the field trip is held in the Easter break (March-May), you will have learned almost all of the year's content. At Arran is where you will see many, if not all, of the theories you have learnt come to life, from volcanics to fossils, from tectonics and folding to sedimentary processes: many confusing things may become clear and click into place here. Highlights include walking through hundreds of millions of years in a day, finding fossilised footprints, touching the edge of a magma intrusion, standing on an ancient desert, staring at a flash flood and making a geological map in the field. Bring a lot of waterproofing: a reliably waterproof jacket, waterproof trousers/overalls, waterproof and grippy walking boots. For notetaking, you are provided

with an A5 notebook; I preferred to use a journalist-style flip notepad, as it fit into my jacket pockets (a lot easier than wrestling it out of a plastic sachet in the wind and rain) and I found it easier to write in.

Revision:

For the essays, attempt as many past essay questions as possible. First, you will get more skillful in writing, managing your time and drawing diagrams (draw large diagrams *with scales* and tables everywhere where possible, they love it). Second, you will see that the topics tend to be repetitive. You have to write 5 essays on the exam, if you are lucky and encounter familiar topics, that would save you loads of time since you do not need to come up with new ideas and structure.

In terms of practicals, you can get the key to the Department for a £10 deposit to get in anytime. If the main gate to Downing Site is locked, use the gate at the junction of Tennis Court Road and Fitzwilliam Street. The lab has a humongous stock of rocks, minerals, fossils and thin sections with booklets containing their description. It is worth going through these several times to make sure you can identify and describe them quickly (aim for under 3-4 minutes). Also re-read through all your practical handouts during the Easter term, they sometimes contain pretty interesting and niche samples - the sort that examiners love to put in their questions. You will not understand all the concepts in Michaelmas but things will start to make sense after Lent and you will learn a lot more by looking back. Try to combine information on related topics, e.g. anything to do with geological history (palaeobiology, rock types in Arran, geological events in the UK, etc.). It will further help your understanding and remembering of certain topics that may seem abstract alone but work when with others.

Definitely visit the Sedgwick Museum of Earth Sciences (and other Natural Sciences museums if you are keen) to do your revision there - it is particularly useful for palaeontology. They have rare examples of fossils that are tricky to identify (e.g. bivalves which look like ideal examples of brachiopods). Do not memorise all the samples, just focus on the different shapes and features. Maybe during the exam, you will recall seeing your sample in Bay 5 of the Museum and will be able to categorise it. Finally, remember to revise your Map notes and keep practising past year papers, including the map questions.

Exams:

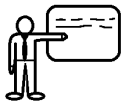
The assessment is 40% Practicals and 60% Written Paper - each paper is 3h long. The practicals consist of 4 questions - rocks, thin sections, fossils and map, so spend no more

than 45 minutes each. The written paper consists of one calculation question and 4 essay questions.

Useful Resources:

- ➔ Sedgwick Museum of Earth Sciences
- ➔ The lab's stash of fossils, rocks and thin sections
- ➔ Kearney, P., Klepeis, K. A. & Vine, F. J. (2009) Global Tectonics, 3rd ed. Hoboken: Wiley-Blackwell.
- ➔ MacKenzie, W. S. & Guilford, C. (1980) Atlas of rock-forming minerals in thin section, 1st ed. Milton Park: Routledge.
- ➔ Collinson, J & Mountney, N. (2019) Sedimentary Structures, 4th ed. Edinburgh: Dunedin Academic Press Ltd.
- ➔ Any extra reading mentioned in lectures (No single textbook covers all bases)

Evolution & Behaviour



Lectures:

Biology at the largest scale is covered by Evolution and Behaviour and provides a broad base for further study across the whole spectrum of biology, from molecular and cellular disciplines, physiology, psychology, to ecology and evolution. It is especially useful as a grounding in genetics. The lecture material is generally quite concept-based, often looking in detail at specific examples and encouraging you to think and read about the topics further. As you progress through the year, you will notice recurring themes that come up in several lecture blocks, and it is often very interesting to link all of these together as E&B is a very holistic science.

Lecture handouts (which are provided at the beginning of each block) for E&B are, on the whole, extremely detailed. Most people don't find it necessary to take detailed notes themselves if they annotate the handouts and review them afterwards, but often spend more time researching more examples and pursuing the suggested further reading lists. Lecturers deliver content in a variety of different ways, but all of them are willing to discuss any questions or problems you may have either at the end of the lecture or by email.

The lecture series titles are listed below:

Michaelmas:

- **Introduction to Evolutionary Biology**
- **Evolutionary Genetics**
- **The First Few Billion Years**
- **The Origin and Evolution of Plants**
- **Diversification of Angiosperms**

Lent:

- **The Evolution of Animal Diversity I: Origins and Relationships**
- **The Evolution of Animal Diversity II: Natural Selection, Plasticity and Adaptive Radiations**
- **Evolution of Behaviour**
- **Human Evolution**
- **Human Population Genetics and Pathogens**

Easter:

- **Global Change I: The Green Extreme**
- **Global Change II: The Past, Present and Future of Biodiversity**

- **Four Billion Years in One Hour**

Supervisions:

Supervisions offer the opportunity to discuss the course content and iron out problems, and aim to help you develop discussion skills out loud and in writing. This means they're often informal, discussion-based sessions where you have a chance to really explore the ideas you may have covered in lectures and practicals. Your supervisor will set you work, mostly essays and essay plans, to prepare you for the types of essay you will need to write in the exams. Don't let writing essays scare you off from taking E&B: your supervisors will definitely help you (they know most NatScis haven't written essays since their GCSEs!) and lots of physicists and chemists find it's a welcome change from solving problem sheets all day. Their feedback on this work can often provide the basis for discussion in the supervision.

Practicals:

The course provides hands-on experience of basic techniques and experimental approaches and an opportunity to see a wide range of organisms, as well as access to the University Museum of Zoology. Practicals are four hours every other week, and all except the first one are formally assessed, so there is no final practical exam – they must be written up and handed in during the practical, and together make up 25% of your total E&B mark. Each practical is led by the current lecturer, so they provide useful and interesting insight into the lecture material, as well as the opportunity to see how some useful results are obtained first-hand. E&B practicals tend to be quite relaxed and they're very much treated as simply an opportunity for you to explore ideas and techniques further. It's made clear which parts are actually assessed, and there are demonstrators who will help you out if you get stuck.

You also have the opportunity to attend one of the one-week field courses in the Easter Vacation, to Devon or Pembrokeshire. These aren't compulsory but are usually the highlight of the year; you can design and carry out your own research project, get to know department members and spend some quality time with your course-mates! If funding is a concern (keeping in mind that the trip is already heavily subsidised by the department), many colleges are happy to provide subsidisation and make sure to ask your DoS if you're not sure.

Revision:

The E&B course is largely concept-based, so once you've understood those, the main thing you need to do is practise exam essays. Your supervisor will give you plenty of guidance on how to plan and write them so you're making the best use of your time, and will often give you a bank of questions you can use to practice. Whole past papers are also available online. Supervisors will usually be happy to give feedback on essay plans and essays throughout the year, although it can be best to start sooner rather than later as they often have a lot of essays to mark just before exams start! At the end of each term it's a good idea to spend some time making a set of general essay plans or templates which you can learn, so then all you need to do in the exam is adapt them to the specific question. It's also really useful to make sure you have a few examples of all of the key concepts so you can discuss them in exams – it's even better if you can find different examples to the ones you are given in the lecture notes, as this will make your answers stand out. For extra examples, Google Scholar is a good resource!

Exams:

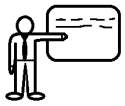
As the practicals are continuously assessed, there is no practical exam so the year ends with one theory paper worth 75% of your overall E&B grade. The format of the exam was recently changed from 2023-24. The paper is 3 hours long and consists of 5 question groups of 2 questions each, picking one essay from each group (i.e. a total of 5 essays). The way the questions are grouped together are random which is a cunning way of making sure you study the whole year's content. The timing works out to be around 35 minutes per question. Timing is crucial in this exam; remember that 5 mediocre essays is better than 4 good essays and 1 unanswered question.

Useful resources:

- Biological Sciences LibGuides- https://libguides.cam.ac.uk/naturalsciences/biosci
- CamGuides- https://camguides.lib.cam.ac.uk/undergraduates.html
- Biological Sciences Libraries- https://www.bio.cam.ac.uk/facilities/libraries
- University Museum of Zoology- https://www.museum.zoo.cam.ac.uk/

- Royle, N. J., Smiseth, P. T. & Kölliker, M. (2012) The Evolution of Parental Care, 1st ed. Oxford: Oxford University Press.
- Ayala, F. J. & Cela-Conde, C. J. (2017) Processes in Human Evolution, 2nd ed. Oxford: Oxford University Press.

Materials Science



Lectures:

The lecture note booklets for this course are very thorough and have consistent formatting throughout the whole year. Most of the notes have a lot of gaps which are filled in during the lecture and once completed contain all of the examinable material. From student experience the first lecture series is quite abstract and difficult to commit to memory at first but it should definitely come clearer as you move onto the other lecture series and the concepts are more applied.

The lecture series titles are listed below:

Michaelmas:

- **A: Atomic Structure of Materials**
- **B: Materials for Devices**
- **C: Diffraction**

Lent:

- **D: Microstructure**
- **E: Mechanical Behaviour of Materials**

Easter:

- **F: Biomaterials**
- **G: Materials Under Extreme Conditions**

Supervisions:

At the back of each lecture booklet are several example sheets. Supervisors will probably ask you to complete one of these sheets every week. Supervisions are majorly based on going through the answers to the questions. The lectures you cover that week should give you all the information you need to complete the questions. Later in the term, the full answers are released on Moodle which is useful for consolidating the correct answers.

Practicals:

Practicals happen once a week (except for one week in Lent to work on the mini project report). For all the practicals, except the very first one, there are pre-practical quizzes with short answers and multiple-choice questions on Moodle to answer before the practical. The

questions are not difficult but the idea behind it is that you read over the method and understand it before arriving at the practical. Altogether these online questions contribute 2.5% of your materials mark. In Lent term, there is a mini project involving deconstructing and analysing the components of a stopwatch. This one involves some research and is submitted close to the start of the Easter break and contributes 10% of your overall mark.

Make sure you sign in when you arrive at a practical and it's important you arrive on time- the demonstrators might turn you away from a practical if you miss the health and safety intro. In general, though, the practicals are pressure-free, with notes guiding you through the experimental steps you should follow and questions to be answered in your notebooks. You can get away with not completing all the tasks, as long as you make sure you can answer questions such as 'what explains this trend in your plot' to the demonstrators when signing out.

The focus of these practicals is not on completing the tasks, but on making sure you understand what's happening and applying the knowledge you gained from the lectures to your observations. The demonstrators are very keen to answer any questions you may have, either directly related to the practical or on the syllabus in general, so you should take advantage of this. The answers should appear on Moodle later as well. The practicals tend to match the content of the lectures quite closely which is good because it lets you see some of the concepts in action!

Revision:

Re-reading lecture notes and revisiting example sheets, as the questions are similar to exam questions, completed for supervisions is a good way to start revising. Past paper questions are also invaluable and the more you do the better. Refer to the 'Useful resources' below as these are also very good for revision. Practice drawing sketches and diagrams as they will definitely come in handy during exams.

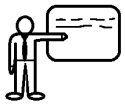
Exams:

There is one exam at the end of the year which is 3 hours long. It has 7 questions of which you need to answer 5. This gives you just over 30 minutes on each question. Each question is worth the same number of marks and it's normally clear which lecture course the question is based on, although some questions still require information from other lecture courses. Good ways of gaining marks include adding relevant extra information and having well-labelled diagrams.

Useful resources:

- ➔ DoITPoMS - https://www.doitpoms.ac.uk/
- ➔ Crystal Maker App (download explained in lecture)

Physics



Lectures:

There is a huge variation in how people find this course since students range from people who haven't taken Physics A-level and those who prepared for Physics olympiads. The first lecture series starts slow, and subsequent series become harder (and for most people, more interesting). If you feel the course is not advanced enough, you can ask your supervisor for additional problems or look online for more difficult questions. By the end of the year, most people find the course challenging. Even though the material starts slow, learning the method of solving physics questions can be hard, so if you're struggling try practising the easiest questions a lot to get the hang of it.

The lecture series titles are listed below:

Michaelmas:

- **Dynamics**
- **Rotational Mechanics and Special Relativity**

Lent:

- **Oscillating Systems**
- **Waves and Quantum Waves**

Easter:

- **Gravitational and Electromagnetic Fields**

Special relativity seems to be a topic which people either understand quickly or struggle with for some time, possibly because it requires a change of mindset. If you are in the latter group, persevere, go through the examples in the notes again by yourself and think over the steps very carefully. You could also search for some general public targeted material online to get a better intuition and feel for the subject.

Because of the broadness of the target audience, many people find IA physics uninteresting. If you were thinking of studying physics before, don't let it put you off completely - things are very different in subsequent years.

Supervisions:

A set of questions is provided by the lecturer, separate from the lecture notes. Each week you'll probably be set 6-8 questions which your supervisor should mark. Supervisions consist of going through the questions and corrections.

Practicals:

The practicals focus strongly on experimental design, error analysis and writing lab reports. You will need to be disciplined at writing up your results concisely with all relevant details. Some of the experiments are quite time-pressured so keep an eye on the clock. The lab staff is there to help you, and it can make a big difference if you ask them when you're stuck or just uncertain (don't be shy, even if they're chatting in the corner you can go over to them). The marks you receive for each practical are formative, and you receive standard credit as long as you finish. While it is commendable to aim for a good mark, the reasoning behind standard credit is to really take time and understand the underlying physics as opposed to trying to write the experiment up very well. In recent years, the practicals in first year have gotten more interesting, and they really improve later in the course. It's sometimes nice to ask the staff more general questions about the experiment to learn interesting stuff beyond the experiment..

Revision:

Doing past papers should be your main method of revision. It's usually advisable to start with papers from many years ago and keep the recent ones for just before the exam. Numerical answers are provided for older papers, and the commentaries are useful to review afterwards. You no longer have a choice to pick which questions you prefer. You may find it helpful to read over your lecture notes on some topics and make a note of formulae that you may need to memorise. You can also try to answer the examples in the lecture notes yourself for more practice.

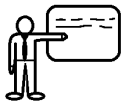
Exams:

Manage your time efficiently in the exam by using the number of marks as a guide to how long a part of a question should take you. Start with questions you are more comfortable with to pick up as many marks as you can early on. Sometimes part of a question can be skipped without sacrificing the rest of the question if you get stuck, so always write as much as you know.

Useful Resources:

- ➔ Feynman lectures on physics - http://www.feynmanlectures.caltech.edu/
- ➔ MIT courses - https://ocw.mit.edu/index.htm
- ➔ Isaac Physics - https://isaacphysics.org/
- ➔ Unofficial answers to Physics papers (Note that these answers are provided by a supervisor and not approved by the department. There may be some inaccuracies.) - IA Physics Google Drive Folder

Physiology of Organisms



Lectures:

Physiology of Organisms (or PoO, pronounced as 'poo', as the organisers insist on calling it) is a very fun subject. It is a comparative course and looks at biological systems across the range of scales, from nutrition in bacteria and single-celled organisms, through insects and mammals, right up to 2,000 tonne sequoia trees. It also looks at biological systems from a range of angles: from biochemistry and medicine as you might expect, right through to physics when you look at how giraffes can drink without having a stroke. Lectures cover a lot of ground and many of the lecturers will give extra details not printed in their notes. It is a fascinating course, relevant to all of the biological subjects in the second year, and interesting to Phys NatScis looking to broaden their horizons. If you are interested in animal or plant documentaries, this subject might just be for you.

There is a bit of overlap with Biology of Cells, especially the cell signalling discussed in Easter term. These subjects complement each other nicely, with details from PoO augmenting Cells essays, and vice versa.

The lecture series titles are listed below:

Michaelmas:

- **Introduction to Physiology**
- **Hormones, Homeostasis and Equilibria**
- **The Nervous System**
- **Muscle and Movement**
- **Cardiovascular Physiology**
- **Animal Nutrient Acquisition**
- **Animal Respiration in Air and Water**
- **Osmoregulation in Animals**

Lent:

- **Energy, Metabolism and Thermoregulation**
- **Plants: Foundation and Change**
- **Plants: Water Carbon and Light**
- **Plants: Underground**
- **Microbial Physiology**

Easter:

- **Comparative Biomechanics**
- **Sensing the Environment**

Supervisions:

Supervisions mainly cover the lecture and practical content for each week. They generally involve conceptual learning and practising data handling questions for practicals. Supervisors may also often set essays as practice and to revise that week's topic. Sometimes you get given information on animals which isn't covered in the lectures, which is very helpful for writing good essays!

Practicals:

Practicals are split between animal physiology and plant physiology. You will have an animal practical class every other week in Michaelmas and Lent terms, and a single animal practical in Easter. You will also have three plant practicals in Lent term. The practicals are generally quite relaxed, and the practical organiser (Dr Mason) thinks that these practicals should be about investigation, rather than following a set of instructions. There is a general guide but you are also allowed to investigate other things that interest you. There will be several animal physiology practicals where you need to design the experiment yourself, considering factors that lead to uncertainty in the data. The plant practicals are a little more formulaic and feel quite like Biology of Cells practicals.

Attendance at the practicals is not compulsory but material covered in the practicals (and not the lectures) will be examined in the practical paper. You are generally welcome to come on a different day to the one in your diary, if for some reason the original day is inconvenient. At the beginning of every practical there is an hour-long debrief session, in which Dr Mason will introduce the practical, and go through results from the previous week. If you miss a practical, definitely try to attend the debrief at the beginning of the next session. Lots of information about the practicals (including debrief sheets and extensions) is uploaded onto the Moodle site, so this should be your first consultation if anything from the practical is unclear.

Revision:

Over the year, you will get a lot of practice writing essays, and you will come to learn what makes a 'good' essay (structure, relevance, detail, diagrams). This is the most useful preparation for the exam - it may well be the case that one of the exam questions is the

same as (or similar to) an essay you have already written. Other good preparation is reading your lecture/supervision notes, reading the textbooks for some extra details, and, in the weeks before the exams, perhaps writing a few essays under timed conditions. One good way to revise is to time and rewrite your essays several times until you can make your wording very precise and finish the essay on time. Your supervisor may or may not be willing to give you feedback on these. Even if they do not, this can still be a useful exercise to give you an idea about how much you can write in an hour, and whether or not writing a plan is a good idea for you. Try to write the essay closed book, then compare against your notes or the textbook to see if you have missed anything.

Only a few multiple choice practical papers and short-answer questions (SAQs) are available on Moodle though there is an ample bank of past essay titles. The best way to revise is just to read the lecture notes and come up with essay plans to organise the content.

The pre- and post-practical quizzes on Moodle are a good way to ensure you understand all of the material. It is not necessary to complete these, but they are a good revision resource. Also useful is looking over your practical notes/Moodle debrief sheets, and skimming through your lecture notes to make sure your grasp of the important concepts is solid.

Exams:

The PoO exam format was recently changed in 2021. There are two PoO exams: a theory exam and a practical MCQ exam.

The theory exam is three hours long and split into two sections: short-answer questions and an essay section. There are 10 SAQs and you are recommended to spend an hour on this (i.e. 6 minutes per question). The questions may touch on anything that has been covered in the theory lectures, therefore it is important to have a rough grasp on all content. The SAQs represent 25% of the overall grade (2.5% for each question).

The essay section of the theory paper represents 50% of the overall grade. You will have to write two essays from a pool of six (i.e. a whopping 25% of your grade comes from one essay). The essays are the most important part of the exam.

The first question contains two possible essay questions relating either to plant OR animal physiology; you can only pick one of the two if you choose Q1. The other four questions (Q2-Q5) are ‘integrative’ questions spanning across multiple kingdoms. Hence you must pick at least one ‘comparative’ essay. Here in the essays you should try to incorporate any additional reading you have done, and anything relevant from your supervisions. Additional

reading is looked upon favourably and will net you a higher score. You will have an hour for each essay, so it is worthwhile to spend a few minutes at the beginning considering the question. Some people find writing an essay outline helpful. This can be a good way to organise your thoughts and make sure that you include everything. Additionally, if you run out of time, the examiner will be able to see your intended essay structure, and give you credit for it.

The most important consideration running through your mind when you answer one of these questions is: 'is what I am writing relevant to the question?'. It is perfectly possible (in fact, quite common) to write a superb essay with material broadly related to the topic, but if you do not actually answer the question, you will not get credit. The most common reason why people score poorly is because the answer was not directly relevant to the question.

The practical MCQ exam is 1.5 hours for 30 questions and accounts for 25% of the grade. The questions are based directly on the practicals (e.g. experimental design choice) with a few questions on calculations that were performed in the practical (e.g. membrane potentials, sweat loss, etc.). Generally people finish the paper well ahead of schedule. It will probably be the most relaxed exam you will ever do in Cambridge, which is always a good thing!

Useful resources:

- ➔ Hill, R.W., Wyse, G.A. & Anderson, M. (2016) Animal Physiology, 4th ed. Sunderland: Sinauer Associates, Inc.
- ➔ Hopkins, W.G. & Hüner, N.P. (2004) Introduction to Plant Physiology, 3rd ed. Hoboken: John Wiley & Sons, Inc.
- ➔ Randall, D., Burggren, W. & French, K. (2002) Eckert Animal Physiology, 5th ed. New York: W.H. Freeman & Co.
- ➔ Schmidt-Nielsen, K. (1997) Animal Physiology, 5th ed. Cambridge: Cambridge University Press.
- ➔ Taiz, L., Zeiger, E., Møller, I.M. & Murphy, A. (2015) Plant Physiology and Development, 6th ed. Sunderland: Sinauer Associates, Inc.

Acknowledgements

Special thanks to Hamish Trowell who started this guide in 2017 and the 2018-2024 SciSoc committees who subsequently updated it.

About SciSoc

The Cambridge University Scientific Society is the largest and most active science society in Cambridge. It was founded in 1995 with the goal of promoting all branches of science within the University and to make science accessible to all members. We organise exciting talks every week and invite the most distinguished scientists and scientific leaders in the UK and the rest of the world, giving our audience the opportunity to engage with some of the greatest minds of our time. Our talks cover some of the most ground-breaking research and cut across all scientific disciplines – Biology, Chemistry, Physics, Mathematics and Medicine. Additionally, we organise dinners, garden parties, pub quizzes and other social events amongst our members and also with other Cambridge societies.

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