Mathematical, Physical and Life Sciences courses at Pembroke College, Oxford

- Biological Sciences
- Chemistry
- Engineering
- Mathematics
- Maths and Philosophy
- Physics
- Physics and Philosophy
According to the 2014 Research Excellence Framework, which is used to assess university research across the UK, the mathematical, physical, engineering and life sciences at Oxford are the best in the country. Pembroke is a great place to study science. Our academics lead research at the cutting edge of science, including robotics and driverless cars, climate change, and particle physics, while providing excellent teaching to our undergraduates. We have a vibrant intellectual community with active student-led societies attracting high profile speakers, and offer fully funded lab internships over the summer to all science students.

UNDERGRADUATE ADMISSIONS AT OXFORD

Full information about applying to Oxford, including submitting your UCAS application, admissions tests, the interview process and the timeline for decisions, can be found at:

https://www.ox.ac.uk/admissions/undergraduate/applying-to-oxford

The information contained in this booklet is correct at the time of printing (May 2017) but is subject to change. Please see the University website (http://www.ox.ac.uk/admissions/undergraduate) for official information about undergraduate admissions and course content; in the event of any discrepancy between the information in this booklet and the University website, the University website should be considered the authoritative source. Due to research leave and changes in personnel, the availability of individual members of staff cannot be guaranteed in any given year.
Pembroke’s library is open 24/7 to members, and has study space over two floors, with power points at every desk and wifi coverage throughout. Students can borrow as many books as they need, and loan periods are for the entire term or vacation. For First Year students, all but the most obscure books should be available in the Pembroke Library, and we have as many as possible for subsequent years.

The Library Staff are able to provide support on finding books both here and in the Bodleian Libraries (and beyond!), using electronic resources, and research support for Undergraduate Theses. We also encourage students to suggest titles to us, and buy as many student requests as possible to make sure every student has what they need to successfully complete their course.
Pembroke normally admits about six undergraduate biologists each year.

A strong academic record in biology, supported by chemistry, physics, mathematics, geography, environmental science or statistics is preferred, though other subject combinations will be considered and judged on individual merits.

A large proportion of Pembroke graduates continue research to M.Sc. and Ph.D. status or follow vocational careers in field-based conservation. Other graduates enter industry, scientific journalism, publishing, computing, teaching or commerce.

Pembroke's Biology Fellows are actively engaged in research across the breadth of the field. Professor Alex Kacelnik is an expert in animal behaviour, with a particular speciality in the study of the tool-making behaviour of crows and cockatoos. Professor Nick Kruger is a plant biochemist with a specific interest in the regulation of carbohydrate metabolism. Professor Mark Fricker works in Plant Sciences researching imaging signalling and transport in complex systems. Professor Kacelnik is due to retire this year, but will continue with his exciting research. His positon is likely to be filled by an expert in animal ecology and the College hopes to announce the new Fellow shortly.

Find out more at:
www.pmb.ox.ac.uk/biology
Professor Ben Davis, Fellow and Tutor of undergraduates at Pembroke was elected a Fellow of the Royal Society in 2015 – in recognition of his world-leading research on the chemistry of carbohydrates and proteins, which has important implications for the development of new drugs to treat serious diseases.

Professor Andrew Baldwin combines NMR spectroscopy, mass spectrometry and electron microscopy to study the structures and dynamics of human ‘molecular chaperone’ proteins (vital to understanding diseases including Parkinsons and Alzheimer’s).

Dr Ann Chippindale’s research interests focus on the synthesis and structural characterisation of materials with interesting chemical and physical properties.

There are three senior academic tutors in Chemistry who are all enthusiastic about teaching while at the same time leading ground-breaking research. Together they have expertise across the breadth of the Chemistry discipline, and beyond – giving our students access to learn from and debate with those who are engaged with the most up-to-date techniques and analysis.

We typically admit six undergraduates each year to read Chemistry, and pride ourselves on developing the full potential of all our students and providing them with excellent support. Many of our recent graduates have gone on to higher degrees in research both at Oxford and around the world: we view Pembroke as an excellent training ground for those dedicated to the sciences.

Visit our website to find out more, including short film pieces featuring undergraduate Chemists: www.pmb.ox.ac.uk/chemistry
Prospective Engineers should have an enthusiasm for the subject and an appreciation of the nature of engineering problems and their solutions. However, we also look for applicants who have creative ability, and who will ultimately contribute to and influence society.

Candidates should be proficient at Mathematics and Physics (a Further Maths A-Level is desirable). A good knowledge of Chemistry (GCSE at least) is also needed as preparation for studies in Mechanical and Electrical Properties of Matter.

Pembroke has three Fellows in Engineering and specialist tutoring in Engineering is also provided by additional Lecturers who are employed by the College.

Professor Nick Hawes’ research applies techniques from artificial intelligence (AI) to allow robots to perform useful tasks for, or with, humans in everyday environments (from moving goods in warehouses to supporting nursing staff in a care home). He is particularly interested in how robots can understand the world around them and how it changes over time (e.g. where objects usually appear, how people move through buildings etc.), and how robots can exploit this knowledge to perform tasks more efficiently and intelligently.

Professor Clive Siviour’s research investigates the behaviour of materials and structures when subjected to impact loading, for example in car crashes or when you drop your mobile phone! Most materials behave very differently when deformed at high speeds, and the research aims to measure and understand this behaviour with a view to better design and use of materials for safety and sustainability. The research is performed on a wide range of materials, including aerospace alloys, polymers and composites.

Professor Ingmar Posner leads the perception and planning work within the Oxford Mobile Robotics Group. His expertise lies in the design and implementation of machine learning methods that enable an autonomous agent to interpret complex dynamic environments in a way which permits robust decision-making, planning and exploration on-line and in real-time. His group’s work finds application for example in the Oxford Robot Car project, as well as in the LUTZ and UK Autodrive autonomous pods being trialled in Milton Keynes.

Find out more at: www.pmb.ox.ac.uk/engineering
Pembroke admits a total of eight candidates a year across the Mathematics and combined disciplines courses. Usually, one of these will be reading Mathematics and Philosophy and the remaining seven candidates will be reading either Mathematics or Mathematical Sciences. Pembroke does not currently admit undergraduates to the courses in Mathematics and Computing or Mathematics and Statistics.

Mathematical courses aim to equip you with the ability to handle abstractions and to analyse problems rapidly and rigorously. The success of Pembroke mathematical graduates in further academic study in mathematics, statistics, computer science and other related fields, as well as in obtaining posts in finance, accountancy, insurance, banking, information technology, statistics and in various engineering concerns is proof of the value of this training.

Find out more about Maths at Pembroke on our website:
www.pmb.ox.ac.uk/maths

Professor Raphael Hauser (above right) and Professor Damian Rössler (above left) are Pembroke’s Fellows in Maths.

Whether you choose a career in business or industry or one in which mathematical skills play a more central role, the Oxford
Maths and Philosophy is a joint honours degree, bringing together the logic and thought of Philosophy with that of Mathematics.

Pembroke has a team of senior academics who tutor on this course, including Professor Raphael Hauser (Applied Maths), Professor Guy Kahane (Philosophy) and Professor Damian Rössler (Pure Mathematics).

Pembroke has a number of undergraduates reading for joint courses and a there is a cohort of Philosophers across the degree courses of:

- Maths & Philosophy
- Psychology, Philosophy & Linguistics
- Philosophy, Politics & Economics (PPE)
- Philosophy & Modern Languages
- Philosophy & Theology.

Find out more at: www.pmb.ox.ac.uk/philosophy

Although a mathematician by training, Damian Rössler is interested in various aspects of the Philosophy of Mathematics, especially in Wittgenstein’s views on the foundations of mathematics. He is also interested in the connections between Algebraic Geometry and Mathematical Logic.

Find out more at: www.pmb.ox.ac.uk/students/admissions/courses/maths-philosophy
The College’s Rokos Awards give Pembroke students a unique opportunity to enhance their studies and scientific knowledge by pursuing further research in an academic setting over the summer vacation.

The Rokos Awards fund academic summer internships in Oxford, including free accommodation in Pembroke, up to £1,000 for academic expenses and £800 for personal expenses.

This opportunity is open to undergraduates studying Biochemistry, Biology, Chemistry, Engineering, Experimental Psychology, PPL, Mathematics, Maths & Philosophy, Physics, Physics & Philosophy, or pre-clinical Medicine.

In 2016 the first cohort of 11 Award recipients from each of these subjects undertook research in a variety of areas, including, for example:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Project Description</th>
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<tbody>
<tr>
<td>Engineering</td>
<td>Noise reduction of civilian drone quadcopter propellers</td>
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<tr>
<td>Biochemistry</td>
<td>Pancreatic beta-cells in type 1 diabetes</td>
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<tr>
<td>Chemistry</td>
<td>Untargeted approaches to identifying xenobiotic molecules from bone extracts</td>
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<tr>
<td>Biology</td>
<td>Analysing anonymised data collected during a study of ‘Smart Specs’</td>
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<tr>
<td>Maths</td>
<td>Distributed approximate interior point methods for big data problems</td>
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<tr>
<td>Psychology</td>
<td>‘Improving Fixational Stability in Cases of Central Vision Loss’</td>
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You can read internship reports by our 2016 Rokos Awardees on the College website: [www.pmb.ox.ac.uk/finance-reports-rokos](http://www.pmb.ox.ac.uk/finance-reports-rokos)

Photos demonstrate the projects that recent Rokos interns have worked on. Dominic McLoughlin (Physics) investigated Eta Carina with the Global Jet Watch Project in 2016 (above).

Rhiannon White (Experimental Psychology), completed an internship with the Perception Lab, University of Oxford.
Physics is one of the most fundamental sciences. Studying physics is analysing nature to understand how the universe works. Studying physics in Oxford equips students with tools needed to understand the world around us, ranging from very small sub-atomic particles, to the large scale structure of the cosmos, and everything in between.

Pembroke admits 6 students each year. Recommended A-level subjects beyond physics and maths are further maths or other sciences. The language of physics is mathematics and to succeed in physics it is almost more important to be comfortable with maths than to be excellent in physics.

Professor Alfons Weber, the College’s Rokos-Clarendon Fellow in Physics, is a particle physicist and has specialised in studying neutrinos and developing instrumentation for research as well as for security applications. He teaches at all levels and especially the sub-atomic part of the course.

Professor Tim Woollings is an Associate Professor in atmospheric physics, with interests in fluid dynamics as applied to both weather and climate science. He teaches mathematics and fluid dynamics from the first year up to graduate level.

Find out more at: [www.pmb.ox.ac.uk/physics](http://www.pmb.ox.ac.uk/physics)
In the past few years the physics community at Pembroke has grown and flourished, with undergraduates, graduate students and tutors alike benefiting from activities outside the normal week of study.

We are always glad to find new students who are keen to be involved in seminars and events which dig deeper into this fascinating science.

Available on our website:
www.pmb.ox.ac.uk/students/admissions/courses/physics

THE DAWN OF GRAVITATIONAL WAVE ASTRONOMY:
Reflections on a Lecture by Professor Alberto Vecchio

Gravitational waves have been heralded as the scientific discovery of the century. Alberto Vecchio, Professor of Astrophysics at the University of Birmingham and part of the international research team that made the discovery, visited Pembroke College February 2016 to explain how they were discovered and what it means for physics. The detection of gravitational waves has opened a new kind of astronomy. For the first time we are able to hear the cosmos, as well as see it. “Every time a new avenue of astronomical observation has been opened up, we have discovered weird and wonderful things - who knows what the era of gravitational waves will bring?”
PHYSICS & PHILOSOPHY

This demanding course brings together the most fundamental subjects in the arts and the sciences. In historic times it would have been a single subject: Natural Philosophy. It covers logic, and general philosophy, philosophy of knowledge, reality, special relativity, and quantum mechanics on one hand, and all the subjects you expect in a physics course with several highly specialised courses in the final years.

We admit up to 2 students every year, who are taught with the Physics and other Philosophy students by our dedicated team of Fellows and tutors, led by Professor Alfons Weber, Professor Tim Woollings and Professor Guy Kahane.

Pembroke has a number of undergraduates reading for joint courses and a there is a cohort of Philosophers across the degree courses of:

- Maths & Philosophy
- Psychology, Philosophy & Linguistics
- Philosophy, Politics & Economics (PPE)
- Philosophy & Modern Languages
- Philosophy & Theology.

Find out more at: www.pmb.ox.ac.uk/physics-philo

Find out more at: www.pmb.ox.ac.uk/philosophy

* In total we admit 8 students to Physics and its joint courses each year.*
All Pembroke students benefit from the financial support available to all Oxford undergraduates – see www.ox.ac.uk/students/fees-funding for full information. In addition, the College provides:

- **Hardship funds** for students who face unexpected difficulties due to changes in circumstances once here.
- **Vacation grants** for students who need to stay in Oxford after the end of term for exams or other study-related reasons.
- **A variety of travel funds** for study-related activities.

Academic excellence is rewarded through annual College Scholarships and Exhibitions, awarded on the basis of performance at public exams and throughout the year. Pembroke has an annual Scholars’ Dinner to celebrate the admission of new Scholars and Exhibitioners. The Scholarships are currently worth £300 and Exhibition £150 per year. Additionally, Scholars and Exhibitioners are currently entitled to a college accommodation grant scheme, worth £1000 for Scholars and £500 for Exhibitioners.

Pembroke also offers a range of special academic prizes and awards specific to a range of subjects, as well as for those involved in sports and the arts at high levels.

Find out more at: www.pmb.ox.ac.uk/finance-undergraduate
Some of the terms used within Oxford University can be confusing at first – here’s a quick-start guide to explain some of the words and phrases you might hear around Oxford.

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<tr>
<th>Battels</th>
<th>The charges made to a member of a college (student or Fellow) for accommodation, meals, etc.</th>
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<tr>
<td>Collections</td>
<td>College exams taken at the start of each term on material covered in the previous term, or in special circumstances</td>
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<td>Coming up/ Going down</td>
<td>Arriving at Oxford at the beginning of the term/ leaving at the end</td>
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<tr>
<td>Division</td>
<td>There are four academic divisions – Humanities; Mathematical, Physical and Life Sciences; Medical Sciences; and Social Sciences.</td>
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<td>Fellows</td>
<td>In colleges, the senior members of college who, together with the college head, constitute the governing body of the college.</td>
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<tr>
<td>Finals</td>
<td>Final examinations at the end of three or four years as an undergraduate student – the level of degree awarded is largely dependent on performance in these exams.</td>
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<td>Formal Hall</td>
<td>A traditional meal held in college. Depending on the college, formal attire and/or gowns may be worn, and guests from outside the college may be invited</td>
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<td>Full Term</td>
<td>The main undergraduate teaching period at Oxford. It lasts for eight weeks and runs from Sunday of First Week to Saturday of Eighth Week.</td>
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<td>Hilary Term</td>
<td>The second of the academic year’s three terms, running from January to mid-March (c.f. Michaelmas, Trinity).</td>
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<tr>
<td><strong>JCR (Junior Common Room)</strong></td>
<td>In addition to being the formal undergraduate student organisation of a college, the Junior Common Room is the hub of undergraduate social activity; also a physical location in a college for student recreation.</td>
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<td><strong>Michaelmas Term</strong></td>
<td>The first term of the academic year which begins in October and ends in December (c.f. Hilary, Trinity).</td>
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<tr>
<td><strong>Matriculation</strong></td>
<td>Matriculation confers membership of the University on those students who are enrolled at the University of Oxford and following a degree-level course.</td>
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<td><strong>Noughtth Week</strong></td>
<td>The week before the beginning of Full Term.</td>
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<td><strong>OUSU</strong></td>
<td>Oxford University Student Union.</td>
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<td><strong>Pigeon Post</strong></td>
<td>Nickname for the University Messenger Service, the free internal mail system.</td>
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<td><strong>Prelims</strong></td>
<td>(abbrev. Preliminaries) Preliminary examinations are first year examinations</td>
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<td><strong>Subfusc</strong></td>
<td>Formal attire worn by students and academics on formal occasions, including matriculation, examinations and graduation. It is made up of a dark suit, skirt or trousers, a white shirt or blouse and a white or black bow tie, black full-length tie or black ribbon, worn with a black gown and a mortar-board. The name derives from the Latin subfuscus, meaning dark brown.</td>
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<td><strong>Trinity Term</strong></td>
<td>Summer term (c.f. Hilary, Michaelmas).</td>
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<td><strong>Tutorial</strong></td>
<td>Undergraduates attend, on average, one hour-long tutorial every week, either on a one-to-one basis or with one or two other students. Students must undertake a considerable number of hours’ preparatory work for each tutorial, including background reading, essay-writing and problem-solving.</td>
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<tr>
<td><strong>Tutor</strong></td>
<td>Someone who teaches students on an individual basis or in pairs. They may be a Fellow, Junior Research Fellow or a graduate. They act as both a teacher and an academic guide.</td>
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<tr>
<td><strong>Vac</strong></td>
<td>Abbreviation of vacation - the periods between terms</td>
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