Programme Information & PLOs

This document forms part of the Programme Design Document and is for use in the roll-out of the York Pedagogy to design and capture new programme statement of purpose (for applicants to the programme), programme learning outcomes, programme map and enhancement plan. Please provide information required on all three tabs of this document.

Title of the new programme – including any year abroad/ in industry variants

MSci & BSc Mathematical Bioscience

Level of qualification

Please select:	Level 7

Please indicate if the programme is offered with any year abroad / in industry variants	**Year in Industry** Please select Y/N	No
	Year Abroad Please select Y/N	No

Department(s):
Where more than one department is involved, indicate the lead department

Lead Department	Natural Sciences
Other contributing Departments:	Biology, Mathematics

Programme leadership and programme team

Please name the programme leader and any key members of staff responsible for designing, maintaining and overseeing the programme.

Jamie Wood (Pathway Leader), Eric Dykeman, Jason Levesley (Ch. BoS), Roddy Vann (Prog. Director)

Particular information that the UTC working group should be aware of when considering the programme documentation (e.g. challenges faced, status of the implementation of the pedagogy, need to incorporate PSRB or employer expectations)

With few exceptions the modules which make up any of the Nat Sci programmes are drawn from the corresponding contributing single subject degree programmes. Local pedagogical practices and modes of assessment are honoured in Nat Sci unless there is evidence that such practices would not be pedagogically sound. Therefore, given the nature of the Nat Sci programmes parts of this document draw liberally from, or make reference to, the corresponding documentation from the contributing departments. This documentation should therefore be considered in parallel with the corresponding proforma for the single subject degree programmes of the contributing departments.

NOTE: Stage 4 is provisional at the moment. There are likely to be changes to this programme, some potentially significant in terms of structure. There needs to be a caveat attached to the Stage 4 provision, but perhaps to the general structure of the programme in general.

Who has been involved in producing the programme map and enhancement plan? (please include confirmation of the extent to which colleagues from the programme team /BoS have been involved; whether student views have yet been incorporated, and also any external input, such as employer liaison board)

The people listed in 14 item have primarily being responsible for the programme map and enhancement plan. At all stages the BoS has had free access to and being invited to comment on the documentation. Student input has been fed into the YP process in a focus group, through the SSLC and via the BoS.

Purpose and learning outcomes of the programme

Statement of purpose for applicants to the programme
Please express succinctly the overall aims of the programme as an applicant facing statement for a prospectus or website. This should clarify to a prospective student why they should choose this programme, what it will provide to them and what benefits they will gain from completing it.

Mathematical Bioscience is a field where the cross application of knowledge and skills between the disciplines of mathematics and biology is key. As research aimed at understanding interrelated ecosystems and ecological systems has become more important to society, so using modelling to predict outcomes, clarify questions, and allow experiments to be undertaken has also become more important. As a Mathematical Bioscience student, you will have a chance to learn about the scope and possibilities of Mathematics when applied to biological and ecological problems; to use mathematical techniques to understand the dynamics of the natural world, with an emphasis on ecology; and the of appropriate mathematical tools, techniques and methodologies for solving real ecologically motivated problems.

The York Mathematical Bioscience programme has been constructed using modules from Biology and Mathematics by experts who are actively researching the very topics that you will study. Therefore a successful Mathematical Bioscience graduate will be prepared for a career using mathematical modelling to interpret biological and ecological scenarios and will be a cross discipline scientist with a skill set that goes beyond the boundaries of their programme.

As a student on the MSci programme you will achieve all the above, but your skills will be developed even further and to a deeper level as you undertake an extended final year research project that will move you towards the research frontier in Mathematical Bioscience, giving you the expertise, skills and experience necessary to pursue graduate level research both within and outside academia.

Programme Learning Outcomes

Please provide six to eight statements of what a graduate of the programme can be expected to do.
Taken together, these outcomes should capture the distinctive features of the programme. They should also be outcomes for which progressive achievement through the course of the programme can be articulated, and which will therefore be reflected in the design of the whole programme.

PLO	On successful completion of the programme, graduates will be able to:
1 BSc	Confidently identify mathematical problems that can be analysed or resolved by standard mathematical techniques, and be able to apply those techniques successfully
1 MSci	Confidently identify complex mathematical problems that can be analysed or resolved by standard mathematical techniques, and be able to apply those techniques successfully with a high level of sophistication
2 BSc	Identify and apply relevant mathematical, numerical or statistical tools, techniques and methodologies to solve real world mathematical modelling problems in a biological, ecological or environmental sciences context
2 MSci	Identify and apply relevant and contemporary mathematical, numerical or statistical tools, techniques and methodologies to solve real world mathematical modelling problems in a specialised biological, ecological or environmental sciences context
3 BSc	Demonstrate breadth and depth of understanding of the fundamentals of genetics, ecology, evolution and the theoretical basis for ecological science, including a critical understanding of the relevant scientific literature.
3 MSci	Demonstrate breadth and depth of understanding of the fundamentals of genetics, ecology, evolution and the theoretical basis for ecological science, including critical appraisal of research at the forefront of the discipline.
4 BSc	Identify and critically evaluate analytical and quantitative techniques and methods through knowledge and first-hand practical experience in laboratories and the field, including the creation of comprehensive laboratory and field reports
4 MSci	Identify and critically evaluate state-of-the-art experimental, analytical and quantitative techniques and methods at the forefront of the discipline through knowledge and first-hand practical experience in laboratories and the field, including the creation of comprehensive laboratory and field reports of a professional standard
5 BSc	Work individually and in groups to solve modelling problems rooted in the biological and environmental sciences by applying logical reasoning, lateral thinking, and mathematical and numerical methodology to develop and implement safe, ethical and socially responsible solutions that benefit humankind
5 MSci	Work individually, in teams and in collaborative groups as a leader or member, to solve complex/unpredictable modelling problems rooted in the biological and environmental sciences by applying logical reasoning, lateral thinking, and mathematical and numerical methodology to develop and implement safe, ethical and socially responsible solutions that benefit humankind
6 BSc	Communicate, in a variety of media, the importance of mathematical, biological or ecological issues to an inter-disciplinary and specialist audience with arguments that are backed up by rigorous data analysis and robust mathematical modelling techniques.
6 MSci	Communicate, with clarity and precision and in a variety of media, the importance of mathematical, biological or ecological issues to an inter-disciplinary, specialist or nonspecialist audience with arguments that are backed up by rigorous data analysis and robust mathematical modelling techniques.
7 BSc	

7 MSci	
8 BSc	
8 MSci	

Programme Learning Outcome for year in industry (where applicable)

For programmes which lead to the title 'with a Year in Industry' – typically involving an additional year – please provide either a) amended versions of some (at least one, but not necessarily all) of the standard PLOs listed above, showing how these are changed and enhanced by the additional year in industry b) an additional PLO, if and only if it is not possible to capture a key ability developed by the year in industry by alteration of the standard PLOs.

NA

Programme Learning Outcome for year abroad programmes (where applicable)

For programmes which lead to the title 'with a Year Abroad' – typically involving an additional year – please provide either a) amended versions of some (at least one, but not necessarily all) of the standard PLOs listed above, showing how these are changed and enhanced by the additional year abroad or b) an additional PLO, if and only if it is not possible to capture a key ability developed by the year abroad by alteration of the standard PLOs.

NA

Explanation of the choice of Programme Learning Outcomes

Please explain your rationale for choosing these PLOs in a statement that can be used for students (such as in a student handbook). Please include brief reference to:

i) Why the PLOs are considered ambitious or stretching?

To fully meet the PLOs given a student will need to embrace both the biological and mathematical aspects of their course, link them together, develop sound experimental techniques and a detailed toolbox for dealing with the outcomes of these experiments, communicate their findings and by the end of degree be able to work at frontier of mathematical biology.

ii) The ways in which these outcomes are distinctive or particularly advantageous to the student:

The juxtaposition of biology and mathematics at the undergraduate level is not a common one and the PLOs ensure that a student who engages with their programme will have acquired a deep insight into both subjects and the links that exist between them. To do so the student will necessarily have to move between the two subjects seamlessly and this will naturally promote lateral thinking. This is certainly distinctive when compared to a single subject student in either discipline where exposure to the other areas is often left to examples or the odd module. The stated PLOs are designed so that this cross disciplinary thinking is woven into the fabric of the programme and that the links are identified from the outset and serve as motivation for and throughout the programme.

iii) How the programme learning outcomes develop students' digital literacy and will make appropriate use of technology-enhanced learning (such as lecture recordings, online resources, simulations, online assessment, 'flipped classrooms' etc)?

Students on Mathematical Bioscience will experience a programme that has technology at its core being a synthesis of biology and mathematics. The practice of mathematical modelling will require a student to use various computer packages to collect, process and analyse data. This data will then be disseminated through various digital media using the appropriate software for the task. Students will further benefit from immersion in two different teaching centres and will have exposure to the technology used in those centres to, amongst other things, deliver lectures and lecture material, setup, circulate and feedback on assessments, encourage students to use digital resources to research topics at the module level and beyond when students engage in the final year research project and communicate with their peers and academics using VLE fora. (PLO 2, 4 & 6 are explicit examples).

iv) How the PLOs support and enhance the students' employability (for example, opportunities for students to apply their learning in a real world setting)?
The programme's employability objectives should be informed by the University's Employability Strategy:

http://www.york.ac.uk/about/departments/support-and-admin/careers/staff/

All the Nat. Sci. programmes have been designed with employability in mind. This is not only as a factor of the design of the programmes themselves, which have had engagement with the University's employability strategy as a given since the early design phases of the programme. But also as a factor of the embedded skills that the contributing departments have built into their modules. Modules which form the bulk of the teaching on this degree programme. Many of the skills listed in the PLOs are generic and will equip the student with a highly transferrable skill set. As an example: PLOs 5 & 6 revolve around such transferrable skills as programming, communication skills and data analysis techniques which are applicable beyond the problems addressed in the programme.

vi) How will students who need additional support for academic and transferable skills be identified and supported by the Department?

Students who need support will generally self identify at admission or early in the Stage 1 and standard University protocols will then be followed. If this isn't the case and a student is identified as needing extra support later in the programme then the student will discuss the matter with their personal supervisor who will advise in accordance with University guidance. Students are assigned a supervisor in one of the contributing departments and have access to a subject facilitator in both contributing departments. The student can approach their supervisor for advice in accordance with University guidelines and seek more specialist advice on a particular discipline from the subject facilitator. Module level issues are handled with the department to which the module belongs and a student can avail themselves off all feedback and quality control mechanisms that the department offers.

vii) How is teaching informed and led by research in the department/ centre/ University?

The very existence of this programme, like all the Nat. Sci. interdisciplinary programmes, is due to the fact that research undertaken in the Departments of Biology and Mathematics has demonstrated a need for graduates who have the skills and techniques to tackle problems of current global significance. The whole programme has being designed by experts actively engaging in research on these very problems, to equip graduates with the necessary skill set to tackle these critical real world problems. The journey that the student will undertake in developing and using these skills culminates in the final year project which will push students to the frontiers of research in the area of Mathematical Bioscience. Therefore research not only informs the teaching on this program, it is the reason that the programme is offered as part of the York Nat. Sci. portfolio.

Stage-level progression

Please complete the table below, to summarise students' progressive development towards the achievement of PLOs, in terms of the characteristics that you expect students to demonstrate at the end of each year. This summary may be particularly helpful to students and the programme team where there is a high proportion of option modules.

Note: it is not expected that a position statement is written for each PLO, but this can be done if preferred (please add information in the 'individual statement' boxes). For a statement that applies across all PLOs in the stage fill in the 'Global statement' box.

Stage 0 (if your programme has a Foundation year, use the toggles to the left to show the hidden rows)							
Stage 1							
On progression from the first year (Stage 1), students will be able to:			*Appreciate the inter-discipilnary nature of Mathematical Bioscience through exposure to the mathematical and biological concepts which make up the program and have developed the core learning stratergies needed to work across different departments, have a solid grounding in the foundations of Mathematical Bioscience, have the core experimental skills necessary to progress further and have begun building a skill set that will allow a student to solve problems using appropriate tools and know how to effectively communincate their findings.*				
PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
Individual statements							
Stage 2							
On progression from the second year (Stage 2), students will be able to:			*Developed further their understanding of mathematics and biology, expanded upon their knowledge base, have enhanced experimental and communication skill sets allowing them to solve increasingly difficult and challenging problems in Mathematical Bioscience, have become more confident independent learners.*				
PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8

Individual statements							

Stage 3	
(For Integrated Masters) On progression from the third year (Stage 3), students will be able to:	*At this stage a Mathematical Bioscience student will have the knowledge, skills and understanding to satisfy all the BSc PLOs and will be equipped to move forward into a more intensely research driven final year.*

PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
Individual statements							

Programme Structure

Module Structure and Summative Assessment Map

Please complete the summary table below which shows the module structure and the pattern of summative assessment through the programme.

'Option modue' can be used in place of a specific named option. If the programme requires students to select option modules from specific lists these lists should be provided in the next section.

From the drop-down select 'S' to indicate the start of the module, 'A' to indicate the timing of each distinct summative assessment point (eg. essay submission/ exam), and 'E' to indicate the end of the module (if the end of the module coincides with the summative assessment select 'EA') . It is not expected that each summative task will be listed where an overall module might be assessed cumulatively (for example weekly problem sheets).

If summative assessment by exams will be scheduled in the summer Common Assessment period (weeks 5-7) a single 'A' can be used within the shaded cells as it is understood that you will not know in which week of the CAP the examination will take place.

Stage 0 (if you have modules for Stage 0, use the toggles to the left to show the hidden rows)

Stage 1

Credits	Module		Autumn Term										Spring Term										Summer Term									
	Code	Title	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	BIO00007C	Genetics	S										EA																			
10	BIO00009C	Genetics and Evolution											S														EA	A	A			
10	BIO00010C	Microbiology	S									E	A																			
20	MAT00003C	Introduction to Applied Mathematics											S													E	A	A	A			
20	MAT00007C	Mathematics for the Sciences 1	S									E	A																			
20	MAT00008C	Mathematics for the Sciences 2												S												E	A	A	A			
30	BIO00012C	Animal and Plant Biology	S										A													E	A	A	A			

Stage 2

Credits	Module		Autumn Term										Spring Term										Summer Term									
	Code	Title	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
20	BIO00053I	Ecology of Animals, Plants and Microbes	S																								EA					
20	BIO00056I	Genes, Genomes, Evolution and Populations	S																								EA					
10	BIO00047I	Big Data Biology												S													EA					
10	BIO00057I	Tutorials	S									A														EA						
10	MAT00027I	Mathematical Skills II	S									A										E	A									
30	MAT00033I	Statistics Option	S										A													E	A	A	A			
10	MAT00041I	Linear Algebra for Natural Sciences	S																			E	A				A	A	A			
10	MAT00030I	Vector Calculus	S										EA																			
10	MAT00024I	Functions of a Complex Variable											S									E				A	A	A				
20	MAT00039I	Applied Maths for Mathematics and Physics											S									E				A	A	A				

Stage 3

Credits	Module		Autumn Term										Spring Term										Summer Term									
	Code	Title	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
20	[new]	Advanced Topics in Evolution and Genetics in Ecology																														
20	[new]	Advanced Topics in Ecology																														
20	[new]	Conservation, Climate Change and Biodiversity																														
20	[new]	Research Group Project (MSci only)	S																A				EA									
40	NAT00001H	Natural Sciences Interdisciplinary Project (BSc only)	S																										EA			
20	MAT00041H	Numerical Analysis	S							A										A		E					A	A	A			
10	MAT00011H	Dynamical Systems	S									E	A																			
10	MAT00012H	Fundamentals of Fluid Dynamics	S									E	A																			
10	MAT00031H	Statistical Pattern Recognition	S									E	A																			
10	MAT00017H	Generalised Linear Models	S									E	A																			
10	MAT00003H	Bayesian Statistics	S									E	A																			
10	MAT00021H	Multivariate Analysis												S								E					A	A	A			
10	MAT00018H	Survival Analysis												S								E					A	A	A			
10	MAT00045H	Time series												S								E					A	A	A			
10	MAT00058H	Practical Data Science in R												S								E					A					
10	MAT00039H	Classical & Biological Fluid Dynamics												S								E					A	A	A			
10	MAT00030H	Stochastic Processes	S									E	A																			
10	MAT00055H	Mathematical Ecology & Epidemiology												S								E					A	A	A			

Stage 4

Credits	Module		Autumn Term										Spring Term										Summer Term									
	Code	Title	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10

60	NAT00002M	Natural Sciences Interdisciplinary Project [CORE]	S																									EA			
20	BIO00056M	Critical Analysis [CORE]	S															A								E					
20	BIO00058M	Data Analysis	S								EA																				
10	MAT00060M	Modelling with MATLAB	S								EA																				
10	N/A	Mathematical Medicine & Biology										S									E					A	A	A			
10	MAT00066M	Applications of Group Theory in Virology										S									E					A	A	A			
The following modules are available on the applied stream only:																															
10	MAT00053M	Partial Differential Equations I	S								E	A																				
10	MAT00078M	Complex and Asymptotic Methods	S								E	A																				
10	MAT00070M	Soft Matter in Physics and Biology										S									E					A	A	A			
10	MAT00079M	Partial Differential Equations II										S									E					A	A	A			
10	MAT00054M	Classical and Biological Fluid Dynamics										S									E					A	A	A			
The following modules are available on the statistics stream only:																															
10	MAT00018M	Stochastic Processes	S								EA																				
10	MAT00039M	Survival Analysis	S								EA																				
10	MAT00040M	Advanced Multivariate Analysis										S									E					A	A	A			

Optional module lists

If the programme requires students to select option modules from specific lists these lists should be provided below. If you need more space, use the toggles on the left to reveal ten further hidden rows.

Option List A	Option List B	Option List C	Option List D	Option List E	Option List F	Option List G	Option List H
Stage 3 Applied Route (BSc)	**Stage 3 Stats Route (BSc)**	**Stage 3 Applied Route (MSci)**	**Stage 4 Applied Route**	**Stage 4 Stats Route**			
20 cr Bio Module	20 cr Bio Module	20 cr Bio Module	BIO00058M	BIO00058M			
20 cr Bio Module	20 cr Bio Module	20 cr Bio Module	20 credits of Maths from modules in above list	20 credits of Maths from modules in above list			
MAT00041H OR MAT00012H+MAT00051H	40 credits of Maths modules		OR 40 credits of Maths from above list and NO BIO00058M	OR 40 credits of Maths from above list and NO BIO00058M			
Stage 3 modules in Bio & Maths subject to change	Stage 3 modules in Bio & Maths subject to change	Stage 3 modules in Bio & Maths subject to change	Stage 4 provision is subject to change	Stage 4 provision is subject to change			

Please note: you need to complete information on all three tabs of this sheet before submitting to the UTC Strategy Working Group.

You are required to submit this information for all undergraduate programme by the 31 July 2016.

Programme Map: Module Contribution to Programme Learning Outcomes

Please complete the summary table below which shows how individual modules contribute to the achievement of programme learning outcomes.

Core modules should be mapped individually. If the programme offers multiple options that contribute to exactly the same PLOs you can group these, providing a statement that articulates how all of these contribute to the achievement of the programme learning outcomes. All modules, both core and optional, should be accounted for in the map.

The table maps the contribution to programme learning outcomes made by each module, in terms of the advance in understanding/ expertise acquired or reinforced in the module, the work by which students achieve this advance and the assessments that test it. This enables the programme rationale to be understood:

· Reading the table vertically illustrates how the programme has been designed to deepen knowledge, concepts and skills progressively. It shows how the progressive achievement of PLOs is supported by formative work and evaluated by summative assessment. In turn this should help students to understand and articulate their development of transferable skills and to relate this to other resources, such as the Employability Tutorial and York Award;

· Reading the table horizontally explains how the experience of a student at a particular time includes a balance of activities appropriate to that stage, through the design of modules.

Note: it is not expected that every module contributes directly to all PLOs, but every module should advance some of them.

Stage 3 Biology modules are still to be constructred and full mapping will only take place one the content is known. Stage 3 & 4 Mathematics modules are currently under review and may change in name and content.

Stage	Module		MSci Programme Learning Outcomes					
			PLO1	PLO2	PLO3	PLO4	PLO5	PLO6

			Confidently identify complex mathematical problems that can be analysed or resolved by standard mathematical techniques, and be able to apply those techniques successfully with a high level of sophistication	**Identify and apply relevant and contemporary mathematical, numerical or statistical tools, techniques and methodologies to solve real world mathematical modelling problems in a specialised biological, ecological or environmental sciences context**	**Demonstrate breadth and depth of understanding of the fundamentals of genetics, ecology, evolution and the theoretical basis for ecological science, including critical appraisal of research at the forefront of the discipline.**	**Identify and critically evaluate state-of-the-art experimental, analytical and quantitative techniques and methods at the forefront of the discipline through knowledge and first-hand practical experience in laboratories and the field, including the creation of comprehensive laboratory and field reports of a professional standard**	**Work individually, in teams and in collaborative groups as a leader or member, to solve complex/unpredictable modelling problems rooted in the biological and environmental sciences by applying logical reasoning, lateral thinking, and mathematical and numerical methodology to develop and implement safe, ethical and socially responsible solutions that benefit humankind**	**Communicate, with clarity and precision and in a variety of media, the importance of mathematical, biological or ecological issues to an inter-disciplinary, specialist or nonspecialist audience with arguments that are backed up by rigorous data analysis and robust mathematical modelling techniques.**
			BSc Programme Learning Outcomes						
			PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**

			Confidently identify mathematical problems that can be analysed or resolved by standard mathematical techniques, and be able to apply those techniques successfully	**Identify and apply relevant mathematical, numerical or statistical tools, techniques and methodologies to solve real world mathematical modelling problems in a biological, ecological or environmental sciences context**	**Demonstrate breadth and depth of understanding of the fundamentals of genetics, ecology, evolution and the theoretical basis for ecological science, including a critical understanding of the relevant scientific literature.**	**Identify and critically evaluate analytical and quantitative techniques and methods through knowledge and first-hand practical experience in laboratories and the field, including the creation of comprehensive laboratory and field reports**	**Work individually and in groups to solve modelling problems rooted in the biological and environmental sciences by applying logical reasoning, lateral thinking, and mathematical and numerical methodology to develop and implement safe, ethical and socially responsible solutions that benefit humankind**	**Communicate, in a variety of media, the importance of mathematical, biological or ecological issues to an inter-disciplinary and specialist audience with arguments that are backed up by rigorous data analysis and robust mathematical modelling techniques.**
Stage 1	Maths for Sciences I	Progress towards PLO	competently use relevant standard mathematical methods	adapt the standard tools to problems slightly outside the standard format			justify the steps and methods used in mathematical arguments	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination			lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises, with the support of seminars and formative feedback through marked work

Stage 1	Maths for Sciences II	Progress towards PLO	competently use relevant standard mathematical methods	adapt the standard tools to problems slightly outside the standard format			justify the steps and methods used in mathematical arguments	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination			lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises, with the support of seminars and formative feedback through marked work
Stage 1	Introduction to Applied Mathematics	Progress towards PLO	competently use relevant standard mathematical methods	adapt the standard tools to problems slightly outside the standard format			analyse the reasoning behind the core dynamics of a mathematical model	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination			lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises, with the support of seminars and formative feedback through marked work
Stage 1	Genetics	Progress towards PLO	Problem solving exercises to develop understanding of genetics. Students can work individually or in groups.		By engaging with core prinicipals of classical and molecular genetics that will be built upon in future modules and Stages.	Gain experience of core techniques such as gel electrophoresis and microscopy		

		By working on (and if applicable, assessed through)	By multiple pen + paper workshop sessions spread throughout the term. 1 hour closed exam		Lectures, pre-recorded material on the VLE, worksheets and set reading. 1 hour closed exam	Three x 3 h practicals		
Stage 1	Genetics & Evolution	Progress towards PLO			Learning and developing an understanding about the principles of genetic analysis, the evolution of genes and genomes, and an introduction to evolutionary and population genetics	Practising the principles of genetic analysis in experimental design and hypothesis testing	By practising the principles of genetic analysis, and evolutionary and population genetics in problem solving exercises.	
		By working on (and if applicable, assessed through)			Listening and engaging with lectures and reading slected chapters in textbooks. Completing a number of VLE based exercises and quizzes that test and direct student learning.. 1 hour closed exam	Practising teachniques and approahces in genetic analysis in problem solving sessions	Participating in problem solving workshops and practiciing the skills required by a Geneticist in lateral thinking and problem solving. 1 hour closed exam	

Stage 1	Microbiology	Progress towards PLO			Exploring the diverse world of microorganisms, including bacteria, archaea, viruses, algae, fungi and protozoa, with particular reference to the relationships between molecular structure and function.	Familiarising with microbiology sterile techniques, appreciating the effect of antimicrobials, learning methods that allow to distinguish different bacteria on the basis of their properties, including biochemical assays, growth curves and microscopy.		
		By working on (and if applicable, assessed through)			Lectures, lectures' files, recorded lectures and study questions in lecture notes and VLE and assessed via a 1.5 h exam	12 h of practical work. Questions on experimental methods are included in the closed exam paper		
Stage 1	Animal & Plant Biology	Progress towards PLO		By carrying out an experiment to investigate how plants respond to temperature	By listening to lectures and reading about the fundamental biology of animals and plants, whilst appreciating the key global problems that Biologists will be required to solve in the 21st century	By working as a group of a number of lab practicals and the design an organism project	By working in a group to explain the key physiological, biochemical and functional characteristics of an organism that enable it to survive an extreme environment	

	Biology	By working on (and if applicable, assessed through)		The collection and analysis of laboratory group data and firsthand experience of presenting results in a structured laboratory report. Assessed via a written practical report.	Lectures and selected chapters from the "How Life Works" textbook. A slection of VLE-based formative test and quizzes. Closed exam x2	Practicals and assessed by lab report	Working in a group to produce a short film to explain key biological adaptations to a non-expert audience. Assessed via the design an organism presentation	
Stage 2	Ecology of Animals, Plants and Microbes	Progress towards PLO		Algorithm/model development, practical-based skills	Acquire understanding of the key processes and theories that underpin function and response, across individuals and communities, of organisms within local and regional environments	Evaluate theory using observational, experimental evidence collected using basic laboratory techniques in lab practicals and field practical. Design functioning algorithm to test ecosystem and organism-appropriate hypotheses	Group work in lab and field practicals and algorithm workshop will develop their understanding of key module concepts and allow student to learn through peer assessment and instruction. Closed exam and open assessment in mid-term will focus on individual self-teaching and motivation.	Groups will present developed models with peer assessment and discussion

		By working on (and if applicable, assessed through)		practicals, workshops	Lectures, practicals, workshops, reading of assigned material, open assessment and exam	Lab practicals, practical workshops, algorithm workshop, closed exam, open assessment	Practicals, workshops, exam and open assessment	Algorithm workshop presentations
Stage 2	Genes, Genomes, evolution & populations [new]	Progress towards PLO		A major focus will be on the interpretation of data and some modelling approaches.	Core principles of evolution. Mechanisms of the change of allele frequencies. Interactions between processes. Effects on the genome, whole organisms and interacting species.	Evaluation of techniques including genomic techniques, evolutionary, population and behavioural modelling etc. and interpretation of data arising from these techniques	Individual and group problem-solving	discussing module related topics in workshops with peers and instructors. Participation in VLE discussion board.
		By working on (and if applicable, assessed through)		Workshop on modelling selection and interpreting outcomes. Interpreting outcomes of genome wide analyses.	Lectures and workshops. Assessed in open exam through problem based questions and case studies, and in closed exam through problem-based questions.	workshops	workshops focussing on population genetic principles, using simple models. Workshop on altruism, and workshop on macroevolution.	workshops, participation in VLE discussion forum

Stage 2	Big Data Biology	Progress towards PLO	Computional processing of large data sets using scripting languages that are broadly useful. Introduction to python.	Workshops require critical analysis of data and interpretation of statistical signals. Hypothesis testing via analysis of data sets. Course provides teaching on data visualisation.	Provides key concepts related to the. mechanisms underlying structure, function and development of living organisms	First hand computational processing and analysis of quantitative data.	Biological problems presented in workshops where students will in groups.	Workshops will teach data visualisation. Written project will develop writing skill.
		By working on (and if applicable, assessed through)	Training in programming (R/Python) and guided processing/analysis of material in tutorials.	Data analysis workshops.	Lectures and workshops throughout the module, private study. Assessed via formative assessements, and written report.	Lectures and data analysis workshops. Assessed via formative assessements, and written report.	Data analysis workshops.	Via written report.
Stage 2		Progress towards PLO	Acquiring a variety of transferable skills relating to problem solving, numerical and computational approaches, working in a team and criticality.		Critical evaluations of scientific literature within tutorials. Also communicating science		Collaborate or work individually to solve more complex problems of a numerical or experimental nature.	Oral presentations, written work, and other communication skills through small group tutorials.

	Tutorials	By working on (and if applicable, assessed through)	Diverse tutorial activities set by the tutor.		Reading and discussing research papers in an area of interest to student and tutor. Formatively. Through feedback on tutorial performance.		Formative problem solving exercises set by the tutor relating to the tutorial topic.	Communications skills are assessed through oral and written and other forms of communication. The appropriateness of the form of communication is assessed for the target audience.
Stage 2	Linear Algebra for Natural Sciences	Progress towards PLO	use the standard methods of basic linear algebra and matrix theory, and their theoretical justification through abstract algebra	apply basic linear algebra and matrix theory to a range of unfamiliar situations	prove standard results in abstract linear algebra		present clear and concise solutions to exercises	
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work	
Stage 2	Vector Calculus	Progress towards PLO	use the standard methods of multi-variable differential and integral calculus to work with functions of many variables and vector fields	apply these standard methods to problems which require a level of interpretation to set up the application			present clear and concise solutions to exercises	

	Vector Calculus	By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination			exercises, with the support of seminars and formative feedback through marked work	
Stage 2	Functions of a Complex Variable	Progress towards PLO	understand and use the standard methods of complex analysis for functions of one complex variable	apply complex analysis to solve problems in applied real analysis, where their use provides quick and powerful solutions	decide when certain methods from complex analysis can, or cannot, be applied and give a justification for this decision		present clear and concise solutions to exercises	
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination.		exercises, with the support of seminars and formative feedback through marked work	
Stage 2		Progress towards PLO						

	Applied Maths for Mathematics and Physics	By working on (and if applicable, assessed through)						
Stage 2	Stats Option	Progress towards PLO	work confidently with a range of statistical tools (both analytically and numerically), statistical inference concepts and techniques, and be able to use probability theory to model a variety of random processes	apply the statistical methods and the framework of applied probabilistic modelling to unfamiliar situations			understand and be able to explain when it is appropriate to use statistical methods or models amongst those covered in the syllabus	present clear and concise solutions to exercises and by building on the skills developed in Introduction to Probability and Statistics, write code in the statistical package R for the statistical analysis of data sets
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination			lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	present clear and concise solutions to exercises and example data sets with the support of example classes

Stage 2	Applied Mathematics Option II	Progress towards PLO	work confidently with the mathematical aspects and foundational ideas in the application of mathematics to modern physics: Newtonian gravity, special relativity, classical and quantum mechanics, waves and fluids	apply a variety of mathematical tools and physical principles to be able to model unfamiliar situations and analyse the consequences of such models			understand and be able to justify the thought processes behind the choice of one or other mathematical tool, or the reasoning and assumptions underlying a particular mathematical model	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination			lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises, with the support of seminars and formative feedback through marked work
Stage 3	Natural Sciences Interdisciplinary project	Progress towards PLO	approach the research boundary	plan a project including identification of appropriate methodologies & techniques	approach the research boundary	plan a project including identification of appropriate methodologies & techniques		communication of work representing the culmination of a BSc in Natural Sciences
		By working on (and if applicable, assessed through)	project investigation; assessed via notebook	production of project plan	project investigation; assessed via notebook	production of project plan		generation of project report, performance in viva and poster presentation to peer group and staff

Stage 3	Dynamical Systems MAT00011H	Progress towards PLO	analyse the qualitative features of simple dynamical systems	adapt standard techniques to unfamiliar nonlinear dynamical systems			justify the conclusions of a qualitative analysis of a nonlinear system	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	exercises, with the support of seminars and formative feedback through marked work
Stage 3	Numerical Analysis	Progress towards PLO	students will be able to apply numerical approximation techniques to a range of standard mathematical problems	students will be provided with a range of approximation techniques that can be used in unfamiliar application problems			students will be able to justify which particular numerical method is appropriate in a given context, and in which sense the approximation error is small	students will be able to communicate mathematical arguments in Numerical Analysis in writing and implement the numerical methods in practice by means of computer packages (such as Maple or Excel) and/or programming languages (such as Java).

		By working on (and if applicable, assessed through)	lecture materials, computer practicals, assessed computer-based coursework, as well as being assessed in the examination	lecture materials, computer practicals			lecture materials, computer practicals, written coursework, and as assessed through examination	lecture material, computer practicals, coursework and assessed written coursework
Stage 3	Research Group Project [new]	Progress towards PLO	Testing hypotheses and executing experiments. Generating data, or analysing large datasets	Training in research methods, approaches and techniques relavant to the group project	Critical reading of scientific papers relating to a define research topic over the course of the preparation of the research project report.		Meetings with group project director and supervision of research work. Assessing and reflecting on progress, evaluating the sucess and efficieny of group/team work.	Communicating complex information in written work
		By working on (and if applicable, assessed through)	Work through research group project. Listening to a lecture on group project work	Methods, techniques and approaches relevant to the research project	Supported by small group or research team activities and meetings		Work as a member of a group or team in a research lab and carryout a research group project as instructed.	Preparation of research report. Lecture on writing skills included in taught element of course.
Stage 3		Progress towards PLO	students will be able to correctly formulate a generalised linear model and use it appropriately in the context of data analysis	students will be able recognise when generalised linear models do not fit the available data and adapt their modelling strategy as appropriate			students will be able to conduct inference using the appropriate tools and be aware of the corresponding assumptions and their consequent limitations	present clear and concise solutions to exercises and students will be able to use the statistical programme R to perform data analysis in the GLM context.

	Generalised Linear Models	By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars and practical sessions, through feedback on marked work and as assessed through examination	theoretical and practical exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars and practical sessions, and as assessed through examination	exercises, with the support of seminars and formative feedback through marked work and example data sets in exercises with the support of computer practical classes
Stage 3	Bayesian Statistics	Progress towards PLO	students will be able to perform a Bayesian analysis of simple statistical models with a conjugate prior distribution, including derivation of the posterior distribution and simulation from the posterior predictive distribution	students will be able to recognize statistical problems which require the application of the Bayes' rule; and to apply the Bayesian inferential approach to unfamiliar simple statistical models			students will be able to interpret numerical summaries of the posterior and predictive distributions, produced by simulation methods	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	exercises, with the support of seminars and formative feedback through marked work

Stage 3	Multivariate Analysis	Progress towards PLO	students will be able to analyse the quantitative features of multivariate data	students will be able adapt standard techniques to unfamiliar multivariate data			students will be able to justify the conclusions of a qualitative analysis of a multivariate data set	present clear and concise solutions to exercises and students will be able to use statistical package R to analyse multivariate data by various techniques
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of practicals, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of practicals, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of practicals, and as assessed through examination	present clear and concise solutions to exercises and examples with the support of computer practical classes
Stage 3	Time series	Progress towards PLO	students will be able to analyse the quantitative feature of time series models	students will be able to adapt standard techniques to unfamiliar time series models			students will be able to justify the conclusions of a quantitative analysis of a time series model	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	exercises, with the support of seminars and formative feedback through marked work

Stage 3	Survival Analysis	Progress towards PLO	understand and be able to use the standard statistical techniques of survival analysis	apply the methods of survival analysis to unfamiliar data sets			explain the criteria for using the statistical models which apply to survival analysis	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of practical sessions, and through feedback on marked work, and as assessed in the examination.	exercises, with the guidance and support of practical sessions, and through feedback on marked work			lecture material and exercises, with the guidance and support of practical sessions, and through feedback on marked work, and as assessed in the examination	exercises, with the support of seminars and formative feedback through marked work
Stage 3	Fundamentals of Fluid Dynamics MAT00012H	Progress towards PLO	students will be able to apply basic fluid dynamics techniques to unfamiliar fluid dynamical problems	students will be able to adapt standard techniques to unfamiliar fluid dynamical problems	students will be able to justify the conclusions of a qualitative analysis of a fluid dynamics problem		present clear and concise solutions to exercises	
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work	

Stage 3	Statistical pattern recognition	Progress towards PLO	students will acquire a range of pattern recognition techniques that can be applied to real world data analysis, particularly classification problems	students will be able to identify and apply the most appropriate techniques to particular problems			students will be able to justify the conclusions of a qualitative analysis of a multivariate data set	present clear and concise solutions to exercises and apply pattern recognition techniques using the statistical package R.
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises in seminars and computer practicals			lecture material and exercises, with the guidance and support of practicals, and as assessed through examination	exercises, with the support of seminars and formative feedback through marked work and example data sets in exercises with the support of seminars and examples classes

Stage 3	Stochastic Processes	Progress towards PLO	students will be able to formulate and analyse mathematical models that take account of the stochastic (random) fluctuations that are always present in the real world. They will acquire a range of mathematical techniques and approximations that can be used to make analytic predictions from stochastic models	students will be able adapt standard techniques to unfamiliar stochastic dynamical systems	students will be able to justify the arguments behind using stochastic models and recognize the difference with deterministic models of behaviour		present clear and concise solutions to exercises	
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work	

Stage 3	Mathematical Ecology & Epidemiology	Progress towards PLO	use a range of mathematical techniques to mathematically model phenomena from the biological sciences	adapt and apply the methods discussed in lectures to other problems in biological or ecological modelling	justify the assumptions which underlie different models and contribute to a group discussion on the uses and meaning of the mathematical models presented in lectures		present clear written or seminar presentations of worked exercises	
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback on marked work and presentations	
Stage 3		Progress towards PLO	apply fluid dynamics techniques to a set of problems in biology	adapt standard applied mathematics techniques to unfamiliar fluid dynamics problems in biology	justify the conclusions of a qualitative analysis of a biological fluid dynamics problem	conduct, independently or in groups, studies on the context or analysis of biological fluid dynamics problems	present clear written or seminar presentations of worked exercises	

	Classical and Biological Fluid Dynamics	By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback during short presentations in seminars	exercises, with the support of seminars and formative feedback on marked work and presentations	
Stage 3	Advanced Topics in Evolution and Genetics in Ecology	Progress towards PLO		Understanding a range of research techniques and approaches in evolutionary ecology, along with their limitations, and describe how they can be applied to particular problems* in rigorous investigations.	Understanding and explaining the major theories underlying the field of evolutionary ecology in terms of underlying assumptions and predictions, Evaluating the strengths and weaknesses of those theories by reference to the empirical evidence, and reading, understanding and criticising the primary research literature from a range of topics in evolutionary ecology			Explaining the major theories underlying the field of evolutionary ecology in terms of underlying assumptions and predictions, evaluating the strengths and weaknesses of those theories by reference to the empirical evidence

		By working on (and if applicable, assessed through)		Lectures and associated workshops and following suggested reading. Closed examination methods questions and essays	Lectures and associated workshops and following suggested reading. Closed examination short answer questions and essays			Formative workshops, attempting past examination papers. Closed examination (written) short answer questions and essays
Stage 3	Advanced Topics in Ecology	Progress towards PLO		Evaluating the strengths and weaknesses of recent technological advances for empirical study of animal behaviour. Critically assessing the value and limitations of a range of approaches to studying behaviour with reference to the empirical evidence.	Understanding and explaining how animal behaviour affects the key decisions in an animal's life and the consequences of behaviour for conservation. Critically assessing the value and limitations of empirical studies, and of models of behaviour with reference to the empirical evidence.	Evaluating the strengths and weaknesses of empirical studies of animal behaviour. Designing empirical tests of underlying theory, within an ethical framework, taking into account conservation implications		Communicating complex information in written work

		By working on (and if applicable, assessed through)		Primary research literature and detailed discussion during interactive lectures.	Primary research literature and detailed discussion during interactive lectures.	Group experimental design tasks during discussion parts interactive lectures, supported by lectures and by reading primary research literature		Workshop, attempting past examination papers, engaging with primary research literature.
Stage 3	Conservation, Climate Change and Biodiversity	Progress towards PLO		Critique current approaches for conserving biodiversity. Evaluate the capacity of humans to manage the environment, and whether and when this is desirable	Assess the causes of these major threats (including habitat destruction, invasive species, and overexploitation - and how these threats are compounded by climate change), and their impacts on biodiversity. discuss the gains as well as losses of diversity, and consider the implications of these changes both for humans and for the animals and plants that share our planet.	Integrate information from different sources in order to design new studies, experiments and research programmes for addressing the conservation of biodiversity. Describe a range of approaches employed in Anthropocene research, along with their strengths and limitations.		Identify which threats have the most detrimental effects on species and ecosystems, and be able to discuss the problems conservationists face in terms of understanding the complexity of these threats.

		By working on (and if applicable, assessed through)		Through debates and group discussions and examination of case studies	Primary research literature and detailed discussion during interactive lectures.	Primary research literature and detailed discussion during interactive lectures.		Through debates and group discussions and examination of case studies
Stage 4	Natural Sciences Research Project	Progress towards PLO	touch upon the research boundary	plan and take ownership of a research project including identification of appropriate methodologies & techniques	touch upon the research boundary	plan and take ownership of a research project including identification of appropriate methodologies & techniques		communication of work representing the culmination of a MSci in Natural Sciences
		By working on (and if applicable, assessed through)	project investigation; assessed via notebook	production of project plan	project investigation; assessed via notebook	production of project plan		generation of project report, performance in viva and poster presentation to peer group and staff
Stage 4	Modelling with MATLAB	Progress towards PLO	write computer code to enable the numerical investigation of mathematical models in the life sciences	interpret empirical data in the context of some appropriate mathematical models			justify the mathematical models being used on the grounds of sound scientific and mathematical principles and relate the techniques to up-to-date research papers	justify the mathematical models being used on the grounds of sound scientific and mathematical principles and be competent with the fundamentals of programming in MATLAB (a mathematical programming language for computation and visualization).

		By working on (and if applicable, assessed through)	lectures and practical sessions, with feedback on formative coursework, and as assessed by coursework.	coursework, with the support of practical sessions			lectures and formative coursework, and as assessed by summative coursework.	lectures and practical sessions, and as assessed through coursework and feedback from marked work
Stage 4	Essential Mathematical Biology	Progress towards PLO	use a range of mathematical techniques to mathematically model phenomena from the biological sciences	adapt and apply the methods discussed in lectures to other problems in biological or ecological modelling			justify the assumptions which underlie different models and contribute to a group discussion on the uses and meaning of the mathematical models presented in lectures	present clear written or seminar presentations of worked exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the support of seminars and formative feedback on marked work and presentations

Stage 4	Stochastic Processes	Progress towards PLO	students will be able to formulate and analyse mathematical models that take account of the stochastic (random) fluctuations that are always present in the real world. They will acquire a range of mathematical techniques and approximations that can be used to make analytic predictions from stochastic models	students will be able adapt standard techniques to unfamiliar stochastic dynamical systems			students will be able to justify the arguments behind using stochastic models and recognize the difference with deterministic models of behaviour	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the support of seminars and formative feedback through marked work

Stage 4	Partial Differential Equations I	Progress towards PLO	use, with a high level of sophistication, a number of standard techniques for analysing and solving linear partial differential equations	adapt standard techniques to unfamiliar partial differential equations			justify the conclusions of a qualitative analysis of a partial differential equation	present clear and concise solutions to exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	exercises, with the support of seminars and formative feedback through marked work
Stage 4		Progress towards PLO	use a range of mathematical techniques to mathematically model phenomena from the biological sciences	adapt and apply the methods discussed in lectures to other problems in biological or ecological modelling			justify the assumptions which underlie different models and contribute to a group discussion on the uses and meaning of the mathematical models presented in lectures	present clear written or seminar presentations of worked exercises

	Ecological Modelling	By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the support of seminars and formative feedback on marked work and presentations
Stage 4		Progress towards PLO	use a range of mathematical techniques to mathematically model phenomena from the biological sciences	adapt and apply the methods discussed in lectures to other problems in biological or ecological modelling			justify the assumptions which underlie different models and contribute to a group discussion on the uses and meaning of the mathematical models presented in lectures	present clear written or seminar presentations of worked exercises
	Biological and Soft Matter	By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the support of seminars and formative feedback on marked work and presentations

Stage 4	Classical & Biological Fluid Dynamics	Progress towards PLO	apply high level fluid dynamics techniques to a set of problems in biology	adapt standard applied mathematics techniques to unfamiliar fluid dynamics problems in biology			justify the conclusions of a qualitative analysis of a biological fluid dynamics problem and conduct, independently or in groups, studies on the context or analysis of biological fluid dynamics problems	present clear written or seminar presentations of worked exercises
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination and exercises, with the guidance and support of seminars, and through feedback during short presentations in seminars	exercises, with the support of seminars and formative feedback on marked work and presentations

Stage 4		Progress towards PLO	understand and be able to use to a high level of competence the statistical techniques of survival analysis	confidently apply the methods of survival analysis to unfamiliar data sets			justify the criteria for using the statistical models which apply to survival analysis	present clear and concise solutions to exercises
	Survival Analysis	By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of practical sessions, and through feedback on marked work, and as assessed in the examination	exercises, with the guidance and support of practical sessions, and through feedback on marked work			lecture material and exercises, with the guidance and support of practical sessions, and through feedback on marked work, and as assessed in the examination	exercises, with the support of seminars and formative feedback through marked work
Stage 4		Progress towards PLO	use basic numerical methods to model solutions to partial differential equations, and estimate the errors inherent in such methods	apply these methods to unfamiliar examples			justify which numerical methods are appropriate for a given problem, and how to control the errors involved	present clear and concise solutions to exercises and coursework and write code in MATLAB in the context of the numerical solution of PDEs

	Partial Differential Equations II	By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of practical classes, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of practical classes, and through feedback on marked work, and as assessed through examination			lecture material and exercises, with the guidance and support of practical classes, and through feedback on marked work, and as assessed through examination	exercises and coursework. With the support of practical classes
Stage 4	Data Analysis	Progress towards PLO		Demonstrate the acquisition of skills in experimental design and data analysis		Evaluate the usefulness of the skills learned for bioscience research at all stages from experimental design to the communication of results	Apply the skills learned to address novel bioscience problems. Reflect on: how the skills learned could be applied in other work at all stages of research, and evaluate their impact on outputs; how the skills might be extended, and how the skills gained might be useful in life after graduation	
		By working on (and if applicable, assessed through)		Data analysis report		Data analysis report	Reflective written assessment	

Stage 4	Critical Analysis	Progress towards PLO				Critically evaluate literature and presentations on research literature and on issues relating to the role of science.	Work within a small team to create, develop and critically review an interdisciplinary research proposal	Communicate scientific research
		By working on (and if applicable, assessed through)				Seminar sized groups undertaking critical reviews of research literature. Each student within the seminar will present critique of two papers over the course of the module	Proposal of a research project (grant proposal) based on an area of interest to the students (group work)	Written and oral presentations
	Due to the recent decision of Planning Committee regarding the MSc in Advanced Mathematical Biology these modules were not expected to be mapped to PLOs.							

Programme Map: Module Contribution to Programme Learning Outcomes

The information provided in this section should make clear why the students are doing the key activities of the programme, in terms of reaching the PLOs. You should use this section to provide commentary on the programme map and how current practice effectively propels student learning. Please indicate any changes that you plan to make to the programme linked to the pedagogic principles.

This section should capture reflections on the programmes and areas for development linked to the principles of the York pedagogy. Please provide an explanation of the programme and assessment design with reference to future enhancements aligned with the pedagogic principles.

Contact with staff
Please explain how the programme's design maximises the value of students' contact time with staff (which may be face-to-face, virtual, synchronous or asynchronous), including through the use of technology-enhanced learning. An example might be giving students resources for their independent study which then enables a class to be more interactive with a greater impact on learning.

You should include:

i. An explanation of how contact with staff in the future programme will be designed to propel student learning

The vast majority of the programme is made up of modules from the Departments of Biology & Mathematics. Therefore the relevant statements made in those department's respective submissions apply here. The final year project is the one exception. This is an interdisciplinary project rather than a project based in one of the contributing departments. Full details of how this project will work in terms of contact hours & supervision are still being discussed.

ii. Changes to the existing programme that will be explored to affect this change; make references to the map to include module level change.

Significant changes have already been made to the structure of the programme due to the early rollout of the YP in Mathematics. There will also be changes due to Biology changing its provision. The net effect on Bio Modelling has been a more streamlined programme with less optionality in Stage 2. But a more focussed programme overall. This reduced optionality is consistent across all Nat Sci programmes. All courses, this one included, are reviewed annually and feedback will be given to all contributing departments. Any further changes that may be necessary will naturally arise during this process of review.

To open up new pathways into the Stage 4 mathematics provision the maths group project in Stage 3 was exorcised from the options list and replaced by two new options in fluid dynamics. The rationale: a Mathememetical Bioscience student already does a group project in Biology. Therefore there was a repetition of learning and skills that would be better replaced adding more intellectual content to the programme, whilst making final year choices more expansive. (Passed by Nat Sci Chairs action)

Students' independent study and formative work

Please outline key features of how independent study and formative work has been designed to support the progressive achievement of the programme learning outcomes. (For example, the use of online resources, which may also incorporate formative feedback; opportunities for further learning from work-based placements).

You should include:

i. An explanation of how students' independent study and formative work has been designed in the future programme to propel student learning?

Again, we refer to the corresponding statements in the mathematics and biology enhancement plans for the reasons stated above. The final year interdisciplinary project is the unique module in this programme. Though the pedagogical philosophy and practice that underpins the project mirrors that of the contributing departments.

ii. Changes to the existing programme to affect this change; make reference to the programme map to indicate module level change

Changes due to the mathematics roll out of the YP are already in place and the Biology changes will be phased in as and when they happen in the single subject degree. Reference is made to the corresponding statement in the mathematics and biology enhancement plans.

(c) Summative Assessment

Please outline how summative assessment within and across modules has been designed to support and evidence the progressive achievement of the programme learning outcomes. (For example, the use of different assessment methods at the 'introduction' stage compared to those used to evaluate deeper learning through the application of skills and knowledge later in the programme).

You should include:

i. An explanation of how formative and summative assessment has been designed in the future programme to propel student learning?

As in Item 5; Nat Sci honours the pedagogical practices of our contributing departments whenever possible and this is certainly the case in summative assessment. The vast majority of the programme is built on modules from the single subject diet and the assessment modes used are judged best to assess the various learning outcomes on these modules. As an example PLOs 1 & 2 will naturally be progressed as the students move through the various stages and chosen modules ramp up in terms of complexity. The same reasoning applies for PLOs 3 & 4 where the progression will flow from the various Biology modules.

ii. Changes to the existing programme to affect this change; make reference to the programme map to indicate module level change

As for item 12.

Support with implementing programme enhancements

Support services will be able to provide guidance on enhancing programmes for example changing assessment and feedback practice, developing students' digital literacy capabilities and technology enhanced learning, employability etc. Please indicate in the space below if you would like additional guidance to implement you enhancements and what support you would require. For more information on the types of support that is available across the University please see the website:

https://www.york.ac.uk/staff/teaching/support/