



Level 3 and Level 4 Module Guide 2019-20

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Biological Sciences



Biological Sciences Programme

The Biological Sciences route begins at level 3 after completion of the core Life Sciences curriculum. The ethos of this programme is to give students a truly research led experience, with virtually all lectures given by research active principal investigators allied with the subject areas.

Students will be exposed to the latest findings in these areas, with researchers using relevant work and current literature to illustrate theory. The overall curriculum allows students to choose modules in specialised areas, defining their final degree topic specialism. In semester one of year three, all Research Divisions contribute to four core modules which prepare students for their specialist topics. Each Research Division provides a module in semester two which acts as an introduction to the current research taking place, with an associated advanced module in semester two of level four. The choice of specialist topics in levels three and four along with the level four research project will define the designation of the final degree award.

In the Honours year, students undertake a research project which is focused on a research question within a laboratory environment; or in the development of educational or learning resources; or the analysis of current literature and data.

This research is supplemented with attendance at invited seminars and lab meetings to immerse students and provide a rich research experience. Semester two features a range of advanced theory modules in specialist areas delivered by research scientists.

BSc Biochemistry

Biochemistry emerged in the twentieth century from a desire to understand the chemical reactions occurring in living organisms and the enzymes that catalyse them. However, modern Biochemistry covers all of the processes occurring in living cells with a particular focus on the structure and function of biomolecules. The goal of Biochemistry is to provide an understanding at the molecular level of complex cellular processes and to explain how they function in both health and disease.

BSc Biological Chemistry and Drug Discovery

BSc Biological Sciences & Drug discovery looks for chemical solutions to biological problems through basic and applied multidisciplinary research. Discovery, characterisation and validation of drug targets in neglected diseases such as trypanosomiasis, leishmaniasis, malaria and other bacterial pathogens is a major research focus. Knowledge gained from these fundamental studies forms the foundation for translation into novel drug-like leads through a combination of high throughput screening, structure based design and medicinal chemistry.

BSc Microbiology

All our research is based around understanding, at molecular, cellular and environmental levels, processes including: protein and ion transport across membranes; multicellular behaviour; signal transduction systems that involve intra- and inter- cellular signalling molecules; the assembly of complex metalloproteins; production, roles and modes of action of bioactive metabolites and antibiotics; metal-mineral-radionuclide transformations; biomineral formation; action of virulence factors and Biosynthesis of the microbial cell wall. We are interested in the processes that govern microbe interactions with hosts, the environment and with other microbes.

BSc Molecular Biology

Molecular Biology is closely related to Biochemistry and studies the complex mechanisms by which our genetic information is interpreted, focussing on the plethora of 'molecular machines' that perform the many functions occurring within living cells and that integrate many cellular and subcellular activities.

BSc Molecular Genetics

Molecular Genetics is the field of biology and genetics that studies the structure and function of genes at a molecular level. Molecular Genetics employs the methods of genetics and molecular biology to elucidate molecular function and interactions among genes.

BSc Biological Sciences

Modern biology is a vast and eclectic field, composed of many branches and sub-disciplines. However, despite the broad scope of biology, there are certain general and unifying concepts within it that govern all study and research, consolidating it into single, coherent fields. In general, biology recognises the cell as the basic unit of life, genes as the basic unit of heredity, and evolution as the engine that propels the synthesis and creation of new species. It is also understood today that all organisms survive by consuming and transforming energy and by regulating their internal environment to maintain a stable and vital condition. Biological scientists have the freedom of the curriculum.

BSc Biological Sciences (Bioinformatics)

Bioinformatics is the research field that seeks to find computational ways of understanding biological systems. The subject is very broad and ranges from research in statistics and computer science, through software engineering and database development, to applications in specific biological systems. The possible biological applications are equally broad, from the study of populations through molecular structure and interactions, to simulations of metabolic and signalling processes.

BSc Biological Sciences (Plant Sciences)

Plants form the basis of life on Earth providing food to sustain human and animal life, as well as being exploited for natural products and medicine. They are essential to the atmosphere in fixing carbon and releasing oxygen. The importance of plant sciences to the world's ecosystems is highlighted by the current concerns over climate change and fuel and food security. We explore and explain the mechanisms by which plants grow and develop in response to their environment, combined with the relevant translation of our scientific activity into crop improvement, biofuel development, and the assessment of biodiversity. With full access to the world-leading molecular research resources of the School of Life Sciences, our labs are based at the James Hutton Institute, 5km from campus. This unique partnership gives us access to state-of-the-art plant growth facilities and collaboration with a wider community of plant scientists.

Biomedical Sciences



Biomedical Sciences Programme

The Biomedical Sciences programme incorporates focused study options in Neuroscience, Pharmacology and Physiological Sciences as well as an opportunity to select modules across disciplines to build a more general Biomedical Sciences study portfolio around your personal interests (restrictions apply). The modules incorporate a research-led teaching approach and are delivered by researchers from the School of Life Sciences and the School of Medicine.

In the Honours year, students undertake either a practical-based research project in a laboratory environment, preparation of educational or science communication materials or a theory-based research dissertation which incorporates data analysis. The choice of module topics in years 3 and 4, along with the subject area of the research project or dissertation, will define the designation of the final degree award.

Overall, the programme provides students with a firm grounding in the current understanding of the structure and function of the human body in health and disease. The goal is to develop students into knowledgeable scientists who possess the necessary skills to flourish in the new era of biomedicine.

BSc Biomedical Sciences

Biomedical Sciences is a flexible programme of study that allows students to study topics from both biological and biomedical programmes alongside core modules covering the physiology and pharmacology of the major human systems. Staff contributing to these modules are based in the Schools of Life Sciences and Medicine. Biomedical Sciences graduates can expect to access a broad range of career and postgraduate training opportunities spanning biomedical research, industry, teaching and healthcare. Graduates are often sought after by employers outside the subject discipline for their scientific training, data handling and problem-solving skills.

At Level 4 you must choose **at least ONE** asterisked (*) module from the module choice table (included at the end of this booklet). Please note that some Biological stream options may have required you to take specific modules at level 3. Please refer to module choice table included at the end of the booklet.

BSc Neuroscience

Neuroscience is the study of the functioning of the nervous system, both in health and disease. The topic ranges from understanding the molecular, biochemical and cellular events that underpin communication between nerve cells, through to the execution of complex behaviours such as playing a piano. Higher cognitive functions, such as learning, memory and emotions ultimately depend upon cellular and neuronal networks that neuroscience endeavours to reveal and explain. The discipline grows in importance to society as the aged proportion of the population increases, bringing new challenges in the treatment and management of neurological disorders.

Block C – You will take two core modules:

- BS42018 Synaptic Plasticity and Cognition
- BS42025 Conscious Brain: The Physiology & Pharmacology of Pain & Anaesthesia.

Block D – You will take two core modules:

- BS42017 Translational Psychiatry & Neurology
- BS42023 Applied Neuroanatomy and Neurodegenerative Disorders.

BSc Pharmacology

Pharmacology is a biomedical science that studies how and where in the body drugs act to produce their effects, from the whole organism down to its individual cells. Most drugs produce their effects by interacting with particular molecular components (e.g. specific proteins) within cells. Pharmacology also considers the body's handling of drugs - how drugs are administered and absorbed, how they distribute within the body, and how they are eventually inactivated and/or excreted, often after being modified in chemical structure by the action of enzymes found in the body.

The term 'drug' encompasses not only the familiar idea of chemicals as medicines (e.g. aspirin, penicillin) or as legal or illegal 'pleasure promoting' agents (e.g. alcohol, cannabis) but also includes poisons such as environmental or industrial pollutants, toxins from snakes and other creatures, and agents (e.g. 'nerve gases') of potential use in chemical warfare. The study of pharmacology therefore has important links with a variety of factors affecting our health and welfare in the modern world.

Block C – You must select a minimum of one of the indicated core options from the following list:

- BS42014 Nutrients & Metabolic Disease
- BS42021 Heart & Circulation
- BS42025 The Conscious Brain: The Physiology & Pharmacology of Pain & Anaesthesia

Note that the above modules are themed by topic area and Block C modules are pre-requisite for the indicated modules in Block D

Please refer to the module choice table at the end of the booklet for specific information.

Block D – You must select a minimum of one of the indicated core options from the following list:

- BS42019 Cardiovascular Pharmacology
- BS42027 Cancer Pharmacology & Treatment
- BS42028 Pharmacology of Treatment of Metabolic Disease

Please refer to the module choice table at the end of the booklet for further information.

BSc Physiological Sciences

Physiology is all about how living organisms function:- for example how blood circulates around the body, how food is digested and absorbed and how muscles use energy during contraction. Its scope ranges from understanding events at the molecular level (e.g. how cells sense nutrients) to the integrative physiology of organs and systems and how they are regulated and adjust to change (e.g. in response to exercise and to environmental extremes such as the microgravity of space flight).

Block C – You must select a **minimum of one** of the indicated core options from:

- BS42014 Nutrients & Metabolic Disease
- BS42021 Heart and Circulation

Then choose either another physiology, pharmacology, neuroscience or a biological module or a level 3 module.

Block D – Students must take two optional modules from the list of physiology, pharmacology, neuroscience or biological module or a Level 3 module.

Please refer to the module choice table at the end of the booklet for further information.

Level 3 Modules

Please refer to the current year's One Stop Shop Module Handbooks for more details

BS31003 Molecular Structure & Interactions [BIO]

The aim of this module is to introduce specific topics within the area of molecular structure and interactions analysis that will underpin the more specialised areas, which students will encounter in semester 2 of level 3 and in level 4. The module also aims to introduce students to the study of interactions that underpin biological events or early stage drug discovery and strengthen students' skills in scientific writing, critical analysis of scientific literature and in self-directed learning.

Topics covered in the module are High-throughput DNA sequencing and genome annotation; Secondary structure, disorder, post-translational modification, cloning and protein purification, single crystal X-ray diffraction methods; NMR, cryo-electron microscopy, calorimetry and thermodynamics, the use of bioinformatics resources and databases; Scientific paper analysis.

BS31004 Biochemistry & Cell Biology [BIO]

The aim of this module is to introduce specific topics within the area of Biochemistry and Cell Biology that will underpin the more specialised areas that students will encounter in semester 2 of level 3 and in level 4. The module also aims to strengthen students' skills in critical analysis of scientific literature, in science communication and in self-directed learning.

Topics covered in the module are separated into four distinct themes: Core Biochemistry (including how proteins function at the molecular level, energy metabolism and photosynthesis); Core Cell Biology, From Tissues To Cells (including cell adhesion, the extracellular matrix and molecular motors); Core Cell Biology, Cell Signaling (including metabolic and developmental signaling pathways); and Systems & Synthetic Biology (including new ways of working and applications of synthetic biology).

BS31005 Genetics [BIO]

We aim to provide an opportunity for students to understand the basics of inheritance, how genomes are structured, and how the function of genes and their variation in populations is analysed. We cover basic principles as well as cutting edge developments. We make an effort to describe key experiments that defined the basis of our understanding of genetics. We aim to break frontal teaching, and to guide students towards reading, understanding and summarizing primary scientific literature using appropriate scientific language. Attending our module is important for students aiming to focus on basic molecular biology, as well as students interested in developmental biology, plant molecular biology, molecular pathology, clinical genetics and inherited disease.

BS31006 Gene Regulation & Expression [BIO]

The aim of this module is to introduce students to specific topics within the area of Gene Regulation and Expression that will underpin the more specialised areas, which the students will encounter in Semester 2 of level 3 and in level 4. This module will focus on the principles underlying the following fundamental processes: transcription, RNA splicing, RNA modification, chromatin and epigenetics, DNA replication, chromosome segregation, DNA recombination and repair. Students will come away with a fundamental understanding of these processes in molecular biology in relation to cellular function and will be able to apply this knowledge to explain mechanisms in biomedically relevant disease states.

BS31013 Biomembranes [BMS]

This module will provide the student with an understanding of the regulation of normal membrane function and the physiological principles underlying this, show how our current understanding of membrane function has been arrived at using examples from current literature, provide an understanding of some basic cellular and molecular physiological and pharmacological techniques and their application to investigate membrane function and enable the acquisition of skills, attitudes and techniques useful in the pursuit of modern biology.

BS31016 Practical Techniques in Biomedical Sciences [BMS]

This module provides practical training in a range of techniques that are fundamental in biomedical research including assessment organ-bath assessment of ligand-receptor interactions, radioligand binding assays, diagnostic applications of enzyme kinetics, history and design of structure of clinical trials, systematic review approaches and meta-analysis. The practical component of this module is complemented by a series of journal club workshops which provide an opportunity to explore wider application of advanced biomedical techniques in the literature. This provides essential preparation for students intending to progress towards honours study.

After successful completion of this module, students should be able to demonstrate knowledge and understanding of receptor pharmacokinetics, pre-clinical methods used in drug screening and development, enzyme-linked diagnostics, clinical trial structure and the systematic, statistical evaluation of clinical trial data.

BS31019 Regulatory Physiology and Pharmacology [BMS]

This module will provide a good understanding of the physiological and pharmacological regulation of body systems for maintaining homeostasis. After successful completion of this module, students should be able to demonstrate knowledge and understanding of how key body systems are regulated by physiological and pharmacological agents in the maintenance of processes such as blood sugar, calcium balance, obesity/appetite/satiety and reproduction.

BS31020 Experimental Cell Culture [BMS]

This module will explore the responses to glucose/insulin and toxic insult by experimentation on cells in culture. The module will provide the student with an understanding of the various ways in which cells respond to their changing environment, show how our current understanding of cell biology has been arrived at using examples from current literature and via replicating classical in vitro experiments, and provide familiarity with some basic biochemical and microscopy techniques as applied to the investigation of cellular biology. It is expected that the module will enable the acquisition of skills, attitudes, techniques and knowledge useful in the pursuit of modern experimental biology.

BS32003 Drug Discovery and Development [BIO]

This module will give an understanding of the process involved in identifying drug targets and developing drugs against that target including assay development. The main topics discussed include target identification, assay development, pharmacokinetics, and structure activity relationships (SAR).

Students will gain a knowledge and understanding of the drug development process from target identification to assay development and pre-clinical trials. They will develop their problem solving skills and engage in group work; statistical analysis of data sets; and the assessment of structure activity relationship data. Likewise it is expected that students will develop the ability to self-assess their understanding of the material and reflect on problem solving.

BS32004 Molecular Microbiology [BIO]

The aim of this module is to introduce students to specialist topics within the areas of bacterial and fungal microbiology. This module will underpin more specialised areas of molecular microbiology that the students will encounter in their Level 4 laboratory projects and in Semester 2 of Level 4. The module aims to strengthen students' skills critical analysis of scientific literature and in self-directed learning.

After completing this module, students should be able to explain broad aspects of microbiology at both the cellular and sub-cellular level. In particular students will understand the principles that underlie the process of:

- how microbes influence the environment
- how microbes colonise a niche
- how microbes grow and develop
- how microbes influence eukaryotes
- the molecular basis of microbial pathogenicity and virulence
- the molecular mechanism of antimicrobials mode of action

BS32005 Cell & Developmental Biology [BIO]

This module is to introduce students to the specialist area of study of developmental biology building on their core curriculum in levels 1 and 2 and semester 1 of level 3. To give the student an understanding of the stages and processes involved in the development of organisms. Topics include: morphogenesis, patterning embryos, patterning tissues, morphogenetic movements, and development and diseases stem cells.

Students will be able to explain broad aspects of the development of vertebrates and invertebrates and what happens when these processes go wrong and will develop their literature review skills, and group working and ways of presenting information in an informative manner.

BS32006 Cell Signalling [BIO]

This aim of this module is to build on the basics of cell signalling introduced during years 1 and 2. It will cover methods of cell-to-cell communication, signal transduction pathways, key proteins in signal transduction and downstream effects. Students will also hone skills in data handling and analysis; oral presentation of work; essay writing; literature analysis; and personal reflection and self-assessment of skills.

BS32007 Organic Synthesis [BIO]

This module should give an in-depth understanding of the main organic reactions used in modern synthetic laboratories with particular respect to the design of molecules for drug discovery.

Students will gain a knowledge and understanding of the main organic reactions and mechanisms. They will be able to predict products of reactions and represent the mechanisms of the reactions using curly arrow notation and be able to design a synthetic strategy to produce a desired product(s).

BS32008 Plant Sciences [BIO]

In this module, we study the fascinating world of plants - incredibly successful organisms which dominate the terrestrial biosphere. We discuss how plants use special developmental strategies and exquisite environmental sensitivity to survive and thrive on land. We also learn how plants interact with other organisms, either to use them to their benefit (pollinators, soil microbiota) or to neutralise them (pests and pathogens). We also explore how domestication and breeding of plants lead to the crop plants we consume today. We also consider unique aspects of plant genomes and how molecular breeding and other biotechnological advances are improving our food security.

BS32009 Immunology [BIO]

This module will provide students with a broad understanding of key topics in immunology. This module will underpin more specialised areas of immunology that the students will encounter in their level 4 laboratory projects and in Semester 2 of Level 4. Students will explore central concepts in the field of immunology and relate this to protection against infectious disease. The module will cover innate immune mechanisms that sense and eliminate pathogens, processing and presentation of antigenic material to drive immune responses, antibody-mediated protection, development and activation of B and T lymphocytes, lymphocyte function, mucosal immune defences, immunological memory and vaccination, immunity to viruses, immunodeficiency diseases, autoimmune diseases and immune hyperreactivity.

BS32010 Applied Bioinformatics [BIO]

This module builds on the basic bioinformatics introduced in levels 1 and 2, and give students a broad understanding of modern bioinformatics using tools for the analysis of next generation sequencing data and the comparison of genome sequences. The module is very much hands on active learning and aims to develop both theoretical understanding and practical skills in this area. It is heavily command line based, using R and Python code. All assessment is through coursework assignments.

BS32011 Practical Project A [BIO]

Finding out about stuff is one of the joys of the life sciences, and especially when you are in control of the experiments – with expert help from senior researchers and the Senior Demonstrators, you will be carrying out a five week project at your own pace – this is how research is done! You will be choosing a project in your area of specialisation, carrying out the research, and writing up a paper on your experience and results for the assessment. This is the best way to see what it's like to carry out research, and will help you get ready for the all-important Honours project in your final year.

This module will build on practical experience in Years 1 and 2 and provide training for the final year research project. This module will offer a range of projects related to specialist modules in semester 2.

Project titles include: Applied Bioinformatics, Microbial Cell Biology, and Molecular Biochemistry

BS32012 Practical Project B [BIO]

Finding out about stuff is one of the joys of the life sciences, and especially when you are in control of the experiments – with expert help from senior researchers and the Senior Demonstrators, you will be carrying out a five week project at your own pace – this is how research is done! You will be choosing a project in your area of specialisation, carrying out the research, and writing up a paper on your experience and results for the assessment. This is the best way to see what it's like to carry out research, and will help you get ready for the all-important Honours project in your final year.

This module will build on practical experience in levels 1 and 2 and provide training for the final year research project. This module will offer a range of projects related to specialist modules in semester 2.

Project titles include: Plant Science, Synthetic Biology, Drug Discovery, and Molecular Ecology

BS32020 Human Epithelial Biology [BMS]

This module provides a solid understanding of the physiology of human epithelial physiology beginning with an overview of epithelial cell structure and organization followed by an exploration of epithelial function in skin (integumentary), renal and gastrointestinal systems. Through a series of lectures, workshops and disease-themed case studies (cystic fibrosis, epidermolysis bullosa, plus renal and gut diseases) students learn key principles of physiology relating to pathogen defense, acid-base balance, regulation of body fluid composition and nutrient digestion and absorption. An understanding of how epithelial systems maintain normal human body function, and the defenses they

mount in response to disease, is essential for any student with an interest in biomedical research and the medical professions.

BS32021 Quantitative Pharmacology [BMS]

This module will provide students with a good understanding of the quantitative aspects of pharmacology including mathematical descriptions of drug/receptor interactions and the handling of drugs by the body (pharmacokinetics).

After successful completion of this module, students should be able to demonstrate receptor theory, including basic mathematical descriptions of receptor occupancy and the nature and diversity of allosteric interactions within receptor complexes, the area of pharmacokinetics and drug disposition within the body and the drug development process.

BS32024 Neuropsychopharmacology [BMS]

This module will provide students with knowledge and understanding about chemical transmission within the central nervous system and how this may be modulated by pharmacological agents to achieve therapeutic benefit in several disorders of nervous system function. It will teach methods in behavioural neuroscience used to study preclinical and clinical drug effects. The module will include teaching contributions from a pharmaceutical industry biochemist to help students understand the challenges of drug discovery in the central nervous system. Students will undertake observation and analysis of neuropharmacology data from a rodent experiment and learn how this would be analysed, presented and interpreted. There will be an emphasis on study of up to date literature to understand current methodology and ideas, along with technical and clinical advances in neuropsychopharmacology.

BS32026 Sensory and Motor Neuroscience [BMS]

This module will provide an opportunity to acquire a good understanding of the physiology and anatomy of systems that govern sensory perception and motor function.

After successful completion of this module, students should be able to demonstrate a knowledge and understanding of how nervous systems, in particular the motor and sensory systems, are built and function, using examples from all stages of neural organization (at the molecular, cellular, circuits and systems levels). The module will emphasize the basic principles required for sensation and action and will build upon the neuroscience content introduced in the core curriculum at Levels 1 and 2.

BS32028 Molecular Pharmacology [BMS]

This module will provide an understanding of the fundamental principles of molecular pharmacology, from drug-receptor interactions to the activation of intracellular signalling cascades.

After successful completion of this module, students should be able to demonstrate and explain the basic principles of receptor pharmacology, the signaling cascades and cell/tissue function influenced by G protein coupled receptor and nuclear hormone receptor activation. The lecture content emphasizes these receptors and their pharmacology in the nervous and immune systems.

BS32029 Cell Proliferation and Survival Mechanisms Underlying Disease [BMS]

This module will provide a firm grounding in key molecular mechanisms and pathways underpinning proliferation and survival relevant to the development of cancer and other disease-related themes at levels 3 and 4. Additionally, to provide an insight into the experimental approaches that have advanced the field of cancer biology.

After successful completion of this module students will develop a knowledge and understanding of cancer-relevant signalling mechanisms including their modulation of gene expression, underlying the control of cell proliferation, cell cycling and programmed cell death.

BS32030 Data and Statistical Analysis [BIO/BMS]

During this module students will develop a deep understanding of the application of statistics to biological and biomedical datasets that is relevant to their further studies and research project work. On completion of the module students should be able to assess and use a range of defined and self-selected learning materials. They will also be able to Assess quality of data, develop an analysis workflow and interpret and present results.

BS32031 Bioinformatics Research Skills 1 [BIO]

Bioinformatics is the management, analysis and modelling of biological data. As modern biological research becomes ever more data rich, the skills required to ask new questions and rapidly filter and process these data should be a part of the biologists toolkit.

This module takes the student from being an end user of bioinformatics applications to one who is developing the skills required for successful manipulation and processing of biological data. We start with data management skills using the Unix operating system – a common base for bioinformatics applications. The bulk of the module is taken up with getting started with programming in Python, probably the most common language in use in biology after English. Finally we introduce good record keeping and version control. In other words electronic record keeping so that our analyses are reproducible.

This module is predicated on students wanting to solve problems, and equipping themselves with the tools to do so. It is mostly self-driven – lectures and problems delivered via video with on-line labs. These are supported with a weekly face to face tutorial. Assessment is a mixture of coursework and a problem solving timed assessment under open book exam conditions.

If you chose this module, you need to be self-motivated, curious and tenacious. One of the key skills is learning how to find the resources to use for successful problem solving. Successful completion will give you a useful toolset for application to many other areas, not least data analysis projects, and a skillset that is attractive to employers.

All the software used is open source and available to run on Mac, PC and Linux desktops.

BS32032 Science Communication [BIO]

The aim of this module is to introduce students to the concepts and history underlying the field of science communication. The content covered in the module will underpin more practical elements of science communication that students may encounter in Level 4 Science Communication Honours projects. Additionally, the skills learnt will be applicable across a broad range of Level 3 and Level 4 courses. The module aims to strengthen student skills in data presentation, communication and critical analysis of texts and other media.

Level 4 Modules

Please refer to the current year's One Stop Shop Module Handbooks for more details

BS41004 Research Project: Biological Sciences [BIO]

Building on their project experience at Level 3, students will expand their research experience by participating in a semester long research project based around one chosen area of the current world-class research in Life Sciences.

Depending on the type of project chosen, students will learn advanced practical techniques and/or enhance their data interpretation skills, analysis of current literature, scientific writing and communication skills. All students will enhance their skills in planning and time management.

Main types of projects are available to students:

- **Individual lab based research** - Students will carry out research into a current topic allied to and within a research group in School of Research School of Life Sciences research complex, James Hutton Institute or Medical Research Institute at Ninewells.
- **Group lab based research** - In groups of no more than four, students will plan and carry out investigations into a current area of research. They will work cooperatively to carry out investigations and produce data but write individual reports.
- **Dissertation with Data Analysis** - A review of the latest scientific literature accompanied by analysis of a relevant data set. Typical types of analyses can include meta analysis, bioinformatics and statistical approaches.
- **Science communication** - In conjunction with Dundee Science Centre or the communications team in the School of Life Sciences or the School of Medicine, students will prepare materials to communicate current research topics and techniques to a public audience
- **Bio-business** – Students will work on a project relating to a biological or biomedical topic, exploring commercialisation, entrepreneurial or business development aspects. This project can include collaboration between an academic group in the School of Life Sciences or the School of Medicine and the Business School or Centre for Entrepreneurship.

BS41005 Research Skills in Biological Sciences [BIO]

The aim of this module is to use the vibrant research environment of the School of Life Sciences, James Hutton Institute and Medical Research Institute at Ninewells to expand the students' experience of current research and give them the opportunity to be part of the wider research culture. Students likewise can engage with science communication, group research and data analysis projects. They will gain knowledge of the current leading areas of research in Life Sciences; enhance their scientific communication skills through writing; and gain experience of grant proposal writing.

Students will prepare a grant proposal in relation to their own research project which will then be presented to and assessed by a panel of current researchers. Following attendance at seminars, students will be able to produce abstracts summarising the subject of at least two of these seminars.

This semester culminates in a research symposium which takes place in the final week of the semester.

BS41006 Research Skills in Biomedical Sciences [BMS]

The aim of this module is to use the vibrant research environment of the School of Life Sciences, James Hutton Institute and Medical Research Institute at Ninewells to expand the students' experience of current research and give them the opportunity to be part of the wider research culture. Students likewise can engage with science communication, group research and data analysis projects. They will gain knowledge of the current leading areas of research in Life Sciences; enhance their scientific communication skills through writing; and gain experience of grant proposal writing.

Students will prepare a grant proposal in relation to their own research project which will then be presented to and assessed by a panel of current researchers. Following attendance at seminars, students will be able to produce abstracts summarising the subject of at least two of these seminars.

This semester culminates in a research symposium which takes place in the final week of the semester.

BS41007 Research Project: Biomedical [BMS]

Building on their project experience at Level 3, students will expand their research experience by participating in a semester long research project based around one chosen area of the current world-class research in Life Sciences.

Depending on the type of project chosen, students will learn advanced practical techniques and/or enhance their data interpretation skills, analysis of current literature, scientific writing and communication skills. All students will enhance their skills in planning and time management.

Main types of projects are available to students:

- **Individual lab based research** - Students will carry out research into a current topic allied to and within a research group in School of Research, James Hutton Institute or Medical Research Institute at Ninewells.
- **Group lab based research** - In groups of no more than four, students will plan and carry out investigations into a current area of research. They will work cooperatively to carry out investigations and produce data but write individual reports.
- **Dissertation with Data Analysis** - A review of the latest scientific literature accompanied by analysis of a relevant data set. Typical types of analyses can include meta analysis, bioinformatics and statistical approaches.
- **Science communication** - In conjunction with Dundee Science Centre, students will prepare materials to communicate current research topics and techniques to a public audience
- **Bio-business** – Students will work on a project relating to a biological or biomedical topic, exploring commercialisation, entrepreneurial or business development aspects. This project can include collaboration between an academic group in the School of Life Sciences or the School of Medicine and the Business School or Centre for Entrepreneurship.

BS42003 Advanced Bioinformatics [BIO]

The aim of this module is to provide specialist knowledge and understanding of frontier topics in bioinformatics. Students will gain an understanding of key technologies and applications in modern biological research and familiarity with state of the art processes.

This module will consist of two study topics delivered by specialists in specific fields and a personal study topic. Indicative content are Genome Assembly, Proteomics, Structural Analysis and Systems Modelling though these may change with research areas and staff availability. Assessment is through preparing literature reviews (precis) of the two assigned topics and a larger mini-review of the students chosen topic.

BS42004 Advanced Modern Drug Discovery [BIO]

The aim of this module is to build upon the students' understanding from level 3 of the process involved in identifying drug targets and developing drugs against those targets. This will include key aspects of drug development beyond lead optimisation.

Topics covered in this module include detailed receptor pharmacology, special considerations for specific drug discovery programmes, including Central Nervous System targets, the role of drug transporters in drug disposition, detailed understanding of what makes a good drug target and a potential drug molecule and introduction to nonclinical development with specific emphasis on safety pharmacology, safety assessment and the more detailed Drug Metabolism and Pharmacokinetic study requirements.

BS42005 Advanced Plant Sciences [BIO]

This module will provide students with an in-depth view of fundamental and applied plant science research and how this can be used to improve food, energy and water security as part of efforts to mitigate climate change and population growth. Lecturers will use their own unpublished discoveries, in combination with recent literature, to deliver a wide ranging and cutting-edge research focussed course examining how does basic scientific data informs crop development, agricultural practice and social policy and benefits human health.

Topics covered in this module include:

- Plant pathology: understanding plant responses to bacterial, oomycete, fungal, nematode and insect pathogens.
- Plant-symbiote interactions: The rhizosphere, the plant microbiome and increased food production
- Biochemistry of plant perception – How plants perceive other organisms, regulate their development and respond to the abiotic environment.
- Regulation of plant development – Can manipulation of plant architecture and flowering time improve food production?
- Identifying plant traits for improved biofuel production – Towards a low carbon plant-based economy.
- Next-generation sequencing and genome capture technology – Identifying genes behind novel traits required for agriculture and industry.
- Synthetic biology: practice and ethics – Can we make a better plant? If we can, should we?
- Plant derived compounds and human health – drug discovery and pharmaceutical production

BS42006 Advanced Immunology [BIO]

The aim of this module is to provide students with an in-depth understanding of a variety of major topics in immunology and to strengthen students' skills in problem solving, critical analysis of scientific literature, and in self-directed learning. Topics in this module cover areas such as antibody biology and engineering, lymphocyte function, inhibitory receptors, cytokine receptor signalling, inflammatory mechanisms, and intracellular immune protection.

BS42007 Cancer Biology [BIO]

The aim of this module is to provide students with a broad understanding of key topics in cancer biology. This module will build on more specialised areas of biochemistry, molecular cell biology and genetics that the students will have encountered in their Level 4 laboratory projects and will complement additional courses in semester 2 of level 4.

Topics covered in this module are Introduction to cancer pathology, Introduction to the Hallmarks of Cancer, Oncogenes, Tumour suppressor genes, Growth factors, Cell signalling pathways, Cancer viruses, Environmental carcinogenesis, DNA damage and repair, Mechanisms of Cell death, Mouse models of cancer and Invasion and metastasis.

BS42008 Stem Cells in Development and Disease [BIO]

The aim of this module is to provide a specialised insight into advanced cell and developmental biology, through the prism of stem cell biology. This module will extend and build on the students' knowledge gained in Level 1 -3 and will provide plenty of opportunities for the students to engage in, as well as critically appraise and evaluate, cutting edge research in highly topical cell and developmental biology subjects in normal and disease

Students will cover the basics of what stem cells are:

The molecular mechanisms required to maintain them or allow them to differentiate into different lineages. In that context we will cover embryonic and adult stem cells in both endogenous and disease states. Example lectures: Introduction to stem cells Embryonic stem cells, Epigenetic regulation in stem cells, Reprogramming/iPS cells Asymmetric cell division, Tissue stem cells Stem cells during development.

BS42009 Advanced Molecular Microbiology [BIO]

The aim of this module is to provide specialised and research-based insight into advanced molecular microbiology. It will extend and build on knowledge gained in Levels 1-3 and will provide extensive opportunities for students to engage with active researchers and primary research literature in areas of topical interest and importance in the field. By successful completion, students will have gained an appreciation and understanding of important topics and current research approaches in molecular microbiology.

After completing this module, students should be able to explain the molecular principles that underlie key traits and processes in microorganisms and should be able to evaluate and refer to relevant primary research sources. In particular:

- how microbes adhere to surfaces
- how bacteria secrete proteins
- how the microbial cell wall is formed
- the biotechnological applications of microbial metal and mineral transformations

BS42010 Advanced Gene Regulation and Expression [BIO]

The aim of this module is to provide an opportunity for students to carry out an in-depth study of specific topics within the area of Gene Regulation and Expression and of the advanced technologies and experimental design that underpin them. Students will gain an understanding of selected topics in cell and molecular biology at the level of contemporary, cutting-edge research in these areas. The selected areas will reflect the expertise and research interests of the Centre for Gene Regulation & Expression in Dundee but will be placed within the wider context of current research.

Specialist topics offered as part of this module may vary from year to year but will typically include five topics drawn from the following areas: transcriptional regulation, chromosome biology, nuclear structure and gene expression, chromatin structure and gene regulation, DNA damage response, control of DNA replication, advanced topics in cell division, advanced proteomics, quantitative and high-resolution microscopy.

BS42011 Advanced Organic Chemistry [BIO]

The aim of this module is to build on levels 1-3 chemistry teaching and to provide students with the core skills required to design synthetic routes towards novel compounds.

On completion of this module, students will gain an understanding of several advanced methods for organic synthesis and organic synthesis design theory. The module will teach an approach to the design of synthetic routes called retrosynthetic analysis. Other topics include organometallic chemistry, palladium catalyzed coupling reactions, peptide synthesis and heterocyclic chemistry.

BS42012 Parasitology [BIO]

The aim of this module is to introduce students to molecular, cellular and biochemical studies on selected parasitic protozoa. Students will gain an understanding of selected parasites, common approaches to their study and development of chemotherapies against them.

Topics covered in this module will include Genetic approaches, Immune evasion, Drug-delivery, Drug targets and Drug mode-of-action.

BS42013 Advanced Cell Signalling [BIO]

This module builds on the level 3 module Cell Signalling (BS32006) and will take students close to the forefront in selected areas of cell signalling research currently being pursued within the School of Life Sciences.

On completion of this module, students should have the ability to acquire, organise, present and discuss information about Cell Signalling obtained from the primary scientific literature and other sources.

Topics covered in this module are protein kinase families; catalysis, regulation and recognition of substrates by protein kinases; sensing of energy and glucose by AMPK; targeting of protein phosphatases via regulatory subunits; organisation of protein phosphorylation networks by 14:3:3 proteins; expansion of cell signalling networks by whole genome duplications; regulation of cell function by polyubiquitylation and deubiquitylation; regulation of transcription by protein phosphorylation; signalling via Toll-like receptors; signalling in T cells via antigen and IL-2 receptors.

BS42014 Nutrients and Metabolic Disease [BMS]

Certain nutrients are potent regulators of cell function alongside their essential role in metabolism. Endocrine and nervous systems of higher animals are often regarded as having the dominant role in regulating the responses of tissues to altered nutrient availability, but there is mounting evidence that particular nutrients (perhaps acting through specific receptor or "sensor" mechanisms) have the capability to initiate cell-signalling events and regulate gene expression independently of hormonal influences. Several dietary factors (including glucose, amino acids, fatty acids as well as micronutrients such as iron) have now been implicated as direct regulators of cell signalling and gene expression events in animal cells.

This module will provide a physiological perspective on the ways in which nutrients (here including fuels) modulate both cellular responses and endocrine/neuropeptide function in mammalian cells with particular emphasis on how such modulation is essential for normal physiological homeostasis and how its dysregulation can contribute to the pathogenesis of insulin resistance, autophagy and metabolic dysfunction, which are commonly associated with clinical conditions such as morbid obesity and Type II diabetes.

BS42017 Translational Psychiatry & Neurology [BMS]

The aim of this module is to introduce students to the psychopathology and treatment of a range of common psychiatric conditions including drug addiction. The module will specifically promote an appreciation of the role of experimental studies of behaviour and neuroimaging of the brain in understanding psychiatric disorders, knowledge of drug treatments available for psychiatric disorder and the rationale to their use, an understanding of the neurobiology and mood disorder schizophrenia, obsessive compulsive disorder (OCD) and addictions, awareness of current research upon drugs of abuse with emphasis upon cannabinoids and the debate regarding the use of such drugs for medicinal purposes.

BS42018 Synaptic Plasticity and Cognition [BMS]

Is synaptic plasticity how the brain learns and remembers? Where in the brain are our memories stored?

This module will take you through the history of how cognitive brain functions were discovered and localised, from early philosophy to modern day neuroscience. You will become familiar with experimental techniques from historical to state of the art that have been used to find out about how organisms learn and remember, including the neuroanatomical, neurochemical and neurophysiological techniques that have been used to study synaptic plasticity. You will learn about the molecular and cellular mechanisms that underlie various forms of synaptic plasticity and how these could support systems level behaviour of whole organisms. You will be encouraged to critically appraise the strengths and weaknesses of different approaches to linking cellular and circuit phenomena to cognition. You will be supported to discuss at a theoretical level how changes in synaptic plasticity may underpin changes at behavioural levels of analysis. Throughout you will be facilitated in critical thinking to consider the validity of the synaptic plasticity and memory hypothesis as the molecular basis of learned behaviour, and to consider whether the hippocampus acts as a cognitive map. This important topic in current neuroscience is still hotly debated today and the question of how our brains learn and remember is still not fully understood, so come and join the discussion!

BS42019 Cardiovascular Pharmacology [BMS]

Students will be exposed to advanced aspects of cardiovascular pharmacology. The module will specifically promote knowledge of: the role of the endothelium, with special emphasis on the role of endothelium-derived vasoactive chemicals, in the intracellular control of vascular smooth muscle tone, detailed understanding of neurohumoral mediators of vascular smooth muscle tone. The module will also provide a comprehensive understanding of the cardiac action potential and the membrane conductances that underlie it, understanding of cardiac ischaemia and the phenomenon of ischaemic preconditioning as a protective mechanism and a knowledge of common cardiac dysrhythmias and their treatment by drugs. Finally the module will consider how the sympathetic nervous system controls cardiac performance, the causes and consequences of heart failure, and current and evolving therapies for the management of heart failure, hypertension and lipid disorders and anti-thrombotic therapy.

BS42021 Heart and Circulation [BMS]

This module will provide the student with an understanding of the physiological control mechanisms in the heart and peripheral circulation as an integrated system, as well as the role of novel signaling pathways (i.e. risk factor pathways) involved in the development of cardiovascular disease and how this can lead to a variety of acute and chronic clinical complications. This will also give students a knowledge base in state-of-the-art biomarker techniques for research in cardiovascular medicine. Students are expected to develop an in-depth, integrated and critical understanding of the physiology and pathophysiology of cardiac muscle and the sino atrial node, the cellular basis of new and evolving therapies, central and hormonal control of cardiac output in health and disease, physiology and pathophysiology of microvascular and macrovascular function and regulation and advantages and disadvantages of current biomarker techniques for evaluation of endothelial function and arterial stiffness.

BS42023 Applied Neuroanatomy & Neurodegenerative Disorders [BMS]

Students will be introduced to the pathology of nervous system function, neural disease and neurodegenerative disorders. The module will specifically promote knowledge of the relationship between abnormal structure of nervous system disease, knowledge of the mechanisms that underlie Alzheimer, Motor neuron, Parkinson and Huntington disease, and appreciation that abnormal protein aggregates are a common feature in neurodegenerative disorders. Current therapeutic strategies available for the treatment of neurodegenerative disorders and the potential for the development of novel treatment strategies will also be addressed.

BS42025 The Conscious Brain: The Physiology & Pharmacology of Pain & Anaesthesia [BMS]

Imagine undergoing major surgery without a general anaesthetic. How do these drugs, within seconds of injection, render us unconscious? How does morphine produce rapid relief from pain, but in some patients may hijack our reward circuitry leading to addiction? Rapid advances are being made in our understanding of how such drugs influence specific neural circuits to produce their dramatic effects on our behaviour. This module will promote an understanding of the mode of action of analgesic and general anaesthetic drugs at an advanced level, specifically it will: (i) relate the complex state of general anaesthesia (sedation, analgesia, cognitive impairment, unconsciousness) to the modulation of specific transmitter-gated ion channels expressed in particular neural circuits (ii) describe how neurosteroids, synthesised in the brain and spinal cord, act as endogenous analgesics, sedatives anxiolytics (iii) investigate how local anaesthetics and morphine act on specific, but distinct targets to produce their effects on the “pain pathway”. (iv) identify emerging targets for new analgesic agents. (v) Finally, prior to, during and after surgery the patient will be managed by multiple drugs. To illustrate the complexities of modern anaesthesia, involving such polypharmacy, a workshop will investigate drug actions on a simulated anaesthetized patient.

BS42027 Cancer Pharmacology & Treatment [BMS]

This module aims to provide students with advanced research-led teaching of key topics in cancer pharmacology and treatment and will build on specialised areas of pharmacology, biochemistry, molecular cell biology and genetics that all students will have encountered through the core modules taken during semester 1 of level 3 and during semester 1 of their level 4 honours year. As this module carries a specialist emphasis on pharmacology, it is also a core complement of the modules which contribute to this degree stream at level 4. The module also aims to strengthen students’ skills in problem solving, critical analysis of scientific literature, and in self-directed learning.

After successful completion of this module students will be able to explain central concepts in the field of cancer pharmacology and relate these to the development and treatment of cancer and will understand the principles that underlie:

- Current approaches to cancer treatment
- Drug targets
- Mechanisms of action of commonly prescribed chemotherapy drugs
- Chemoprevention
- Drug resistance
- Cancer stem cells
- Cancer pharmacogenetics
- Personalised medicine for cancer

BS42028 Pharmacology of Treatment of Metabolic Disease [BMS]

This module aims to provide students with advanced research-led teaching of key topics in the clinical pharmacology of treatment of Obesity, Diabetes, Fatty liver Disease and metabolic diseases of the brain. This module will build on specialised areas of physiology, biochemistry, molecular cell biology and genetics that students will have encountered through the core modules taken during semester 1 of level 3, and during BS42014, which must be taken alongside this module.

Following successful completion of this module, students will be able to explain and critically appraise central concepts in the field of the pharmacology of treatments for metabolic diseases and the associated health complications. Clinical aspects of the diseases and their treatments will be covered to ensure students appreciate the 'real-life' aspects of dealing these diseases.

Students will understand the principles that underlie:

- Glucose Metabolism and Different types of diabetes
- Pathophysiology of the different types of diabetes
- Current approaches to treatment of metabolic diseases
- Medical Complications of diabetes and their treatment
- Mechanisms of action of commonly prescribed diabetes drugs
- Diabetes pharmacogenetics
- Personalised medicine for diabetes
- Molecular and clinical aspects of Fatty Liver disease and Hepatitis
- Metabolic diseases of the brain
- Important aspects of Clinical Trial design
- New treatments on the horizon

Level 3 Module Choice Table – Biological Sciences

| | | Pre & Co-requisites | Biochemistry BIOC | Biological Chemistry & Drug Discovery BCDD | Microbiology MBIO | Molecular Biology MOLB | Molecular Genetics MOLG | Biological Sciences and Specialisms | | |
|------------------|---|--|-------------------|--|-------------------|------------------------|-------------------------|-------------------------------------|---|---|
| | | | | | | | | Biological Sciences BIOLOGSCI | Biological Sciences (Bioinformatics) BSBI | Biological Sciences (Plant Sciences) BSPS |
| Sem 1 | BS31003 Molecular Structure & Interactions | - | Core | Core | Core | Core | Core | Core | Core | Core |
| | BS31004 Biochemistry & Cell Biology | - | Core | Core | Core | Core | Core | Core | Core | Core |
| | BS31005 Genetics | - | Core | Core | Core | Core | Core | Core | Core | Core |
| | BS31006 Gene Regulation & Expression | - | Core | Core | Core | Core | Core | Core | Core | Core |
| Sem 2 Block C | BS32003 Drug Discovery & Development | - | - | Core | Option | Option | Option | Option | Option | - |
| | BS32004 Molecular Microbiology | - | - | Option | Core | Core | Option | Option | Option | Option |
| | BS32006 Cell Signalling | - | Core | Option | Option | Option | Option | Option | Option | Option |
| | BS32008 Plant Sciences | - | - | Option | Option | Option | Option | Option | Option | Core |
| | BS32011 Practical Project A | - | Core | Option | Core* | Core* | Core* | Core* | Core | Option |
| | BS32029 Cell Proliferation and Survival Mechanisms Underlying Disease | Required for students intending to take Cancer Biology and/or Cancer Pharmacology & Treatment at level 4 | - | Option | Option | Option | Option | Option | Option | - |
| | BS32030 Data and Statistical Analysis | - | - | Option | Option | Option | Option | Option | Option | Option |
| | BS32031 Bioinformatics Research Skills I | Can not take this module if taken BS21010 at level 2 | - | Option | Option | Option | Option | Option | Option | Option |
| Sem 2 Block D | BS32005 Cell & Developmental Biology | - | Option | - | Option | Option | Option | Option | Option | Option |
| | BS32007 Organic Synthesis | - | - | Core | Option | Option | Option | Option | Option | - |
| | BS32009 Immunology | - | Option | - | Option | Option | Option | Option | Option | Option |
| | BS32010 Applied Bioinformatics | - | Option | - | Option | Option | Option | Option | Core | Option |
| | BS32012 Practical Project B | - | Option | Core | Core* | Core* | Core* | Core* | Option | Core |
| | BS32032 Science Communication | - | Option | - | Option | Option | Option | Option | Option | Option |

PLEASE NOTE ONLY TWO MODULES ARE TAKEN IN BLOCK C AND IN BLOCK D

Core* = These are compulsory modules to Biological Stream, however students must select practical Project A in block C AND/OR practical Project B in block D

Level 3 Biomedical Stream Modules may be available as Elective Choices only under guidance and where scheduling permits

Disclaimer: Please note that modules normally require a minimum number of enrolled students in order to run. If this minimum is not achieved, the module may be withdrawn for the relevant academic year.

Level 3 Module Choice Table – Biomedical Sciences

| | | | Pre & Co-requisites | Biomedical Sciences BIMS | Neuroscience NEUR | Pharmacology PHAR | Physiological Sciences PHSC |
|-------|---------|---|---|--------------------------------|----------------------|----------------------|-----------------------------------|
| Sem 1 | BS31004 | Biochemistry & Cell Biology | Students MUST have taken BS31004 if they intend to take BS32006 AND/OR BS32005 in SEM 2 | Option | Option | Option | Option |
| | BS31006 | Gene Regulation & Expression | | Option | Option | Option | Option |
| | BS31013 | Biomembranes | | Core | Core | Core | Core |
| | BS31016 | Practical Techniques in Biomedical Sciences | | Core | Core | Core | Core |
| | BS31019 | Regulatory Physiology and Pharmacology | | Core | Core | Core | Core |
| | BS31020 | Experimental Cell Culture | | Option | Option | Option | Option |

| | | | | | | | |
|------------------|---------|---|---|--------|--------|--------|--------|
| Sem 2 Block C | BS32006 | Cell Signalling | BS31004 or BS31020 | Option | Option | Option | Option |
| | BS32026 | Sensory and Motor Neuroscience | | Option | Core | Option | Core |
| | BS32028 | Molecular Pharmacology | | Option | Option | Core | Option |
| | BS32029 | Cell Proliferation and Survival Mechanisms Underlying Disease | Required for students intending to take Cancer Biology and Cancer Pharmacology & Treatment at level 4 | Option | Option | Option | Option |
| | BS32030 | Data and Statistical Analysis | | Option | Option | Option | Option |
| | BS32031 | Bioinformatics Research Skills I | Can not take this module if taken BS21010 at level 2 | Option | Option | Option | Option |

| | | | | | | | |
|------------------|---------|------------------------------|--------------------|--------|--------|--------|--------|
| Sem 2 Block D | BS32005 | Cell & Developmental Biology | BS31004 or BS31020 | Option | Option | Option | Option |
| | BS32009 | Immunology | | Option | Option | Option | Option |
| | BS32020 | Human Epithelial Biology | | Option | Option | Option | Core |
| | BS32021 | Quantitative Pharmacology | | Option | Option | Core | Option |
| | BS32024 | Neuropsychopharmacology | | Option | Core | Option | Option |
| | BS32032 | Science Communication | | Option | Option | Option | Option |

PLEASE NOTE ONLY TWO MODULES CAN BE TAKEN IN BLOCK C AND BLOCK D

Level 3 Biological Stream Modules may be available as Elective Choices only under guidance and where scheduling permits

Disclaimer: Please note that modules normally require a minimum number of enrolled students in order to run. If this minimum is not achieved, the module may be withdrawn for the relevant academic year.

Level 4 Module Choice Table – Biological Sciences

| | | Pre & Co-requisites | Biochemistry BIOC | Biological Chemistry & Drug Discovery BCDD | Microbiology MBIO | Molecular Biology MOLB | Molecular Genetics MOLG | Biological Sciences and Specialisms | | |
|------------------|---------|---|---------------------|--|-------------------|------------------------|-------------------------|-------------------------------------|--------|--------|
| Sem 1 | BS41004 | Research Project: Biological Sciences | Core | Core | Core | Core | Core | Core | Core | Core |
| | BS41005 | Research Skills in Biological Sciences | Core | Core | Core | Core | Core | Core | Core | Core |
| Sem 2 Block C | BS42003 | Advanced Bioinformatics | Option | Option | Option | Option | Option | Option | Core | Option |
| | BS42004 | Advanced Modern Drug Discovery | BS32003 or BS32007 | - | Core | Option | Option | Option | Option | - |
| | BS42006 | Advanced Immunology | BS32006 and BS32009 | Option | - | Option | Option | Option | Option | - |
| | BS42007 | Cancer Biology | | Option | Option | Option | Option | Option | Option | - |
| | BS42008 | Stem Cells in Development and Disease | | Option | - | Option | - | Option | Option | - |
| | BS32004 | Molecular Microbiology | | Option | Option | - | - | Option | Option | Option |
| | BS32006 | Cell Signalling | | - | Option | Option | Option | Option | Option | Option |
| | BS32030 | Data and Statistical Analysis | | Option | Option | Option | Option | Option | Option | Option |
| Sem 2 Block D | BS42005 | Advanced Plant Sciences | | Option | Option | Option | - | Option | Option | Core |
| | BS42009 | Advanced Molecular Microbiology | | Option | Option | Core | Core | Option | Option | Option |
| | BS42010 | Advanced Gene Regulation and Expression | | Core | Option | Option | Core | Core | Option | Option |
| | BS42011 | Advanced Organic Chemistry | BS32007 | - | Core | Option | - | Option | Option | - |
| | BS42012 | Parasitology | | Option | Option | Option | - | Option | Option | Option |
| | BS42013 | Advanced Cell Signalling | BS32006 | Option | Option | - | - | Option | Option | Option |
| | BS42027 | Cancer Pharmacology and Treatment | | Option | Option | - | - | Option | Option | - |

PLEASE NOTE ONLY TWO MODULES ARE TAKEN IN BLOCK C AND IN BLOCK D

Level 3 and/or Level 4 Biomedical Stream Modules may be available as Elective Choices only under guidance where scheduling permits

Students may select up to two level 3 modules across Blocks C OR Block D. Where space is limited, level 3 students shall have precedence.

Disclaimer: Please note that modules normally require a minimum number of enrolled students in order to run. If this minimum is not achieved, the module may be withdrawn for the relevant academic year.

Level 4 Module Choice Table - Biomedical Sciences

| | | | Pre & Co-requisites | Biomedical Sciences BIMS | Neuroscience NEUR | Pharmacology PHAR | Physiological Sciences PHSC |
|-------|---------|--|---------------------|--------------------------|-------------------|-------------------|-----------------------------|
| Sem 1 | BS41006 | Research Skills in Biomedical Sciences | - | Core | Core | Core | Core |
| | BS41007 | Research Project: Biomedical Sciences | - | Core | Core | Core | Core |

| | | | | | | | |
|------------------|---------|--|---|---------|------|--------|--------|
| Sem 2 Block C | BS42007 | Cancer Biology | BS32029 | Option | - | Option | - |
| | BS42014 | Nutrients & Metabolic Disease | - | Option | - | Core* | Core* |
| | BS42018 | Synaptic Plasticity and Cognition | - | Option | Core | - | - |
| | BS42021 | Heart and Circulation | - | Option | - | Core* | Core* |
| | BS42025 | The Conscious Brain: The Physiology & Pharmacology of Pain & Anaesthesia | - | Option | Core | Core* | Option |
| | BS42006 | Advanced Immunology | BS32009 and either BS32006 or BS32028, all taken at level 3 | Option* | - | Option | Option |
| | BS42008 | Stem Cells in Development & Disease | - | Option* | - | Option | Option |
| | BS32006 | Cell Signalling | - | Option* | - | Option | Option |
| | BS32030 | Data and Statistical Analysis | - | Option* | - | - | - |
| | BS32031 | Bioinformatics Research Skills 1 | Can not take this module if taken BS21010 at level 2 | Option* | - | - | - |

| | | | | | | | |
|------------------|---------|--|-------------------------------------|---------|------|--------|--------|
| Sem 2 Block D | BS42017 | Translational Psychiatry & Neurology | - | Option | Core | Option | Option |
| | BS42019 | Cardiovascular Pharmacology | BS42021 | Option | - | Core* | Option |
| | BS42023 | Applied Neuroanatomy and Neurodegenerative Disorders | - | Option | Core | - | Option |
| | BS42027 | Cancer Pharmacology and Treatment | BS42007 and BS32029 | Option | - | Core* | - |
| | BS42028 | Pharmacology of Treatment of Metabolic Disease | BS42014 | Option | - | Core* | Option |
| | BS42009 | Advanced Molecular Microbiology | - | Option* | - | - | - |
| | BS42012 | Parasitology | - | Option* | - | - | - |
| | BS42013 | Advanced Cell Signalling | BS32006 taken at level 3 | Option* | - | - | - |
| | BS32005 | Cell & Developmental Biology | BS31004 or BS31020 taken at level 3 | Option* | - | - | - |
| | BS32009 | Immunology | - | Option* | - | - | - |
| | BS32021 | Quantitative Pharmacology | - | - | - | - | Option |
| | BS32024 | Neuropsychopharmacology | - | - | - | - | Option |

PLEASE NOTE ONLY TWO MODULES CAN BE TAKEN IN BLOCK C AND BLOCK D

Core* = Must take a minimum of ONE of the indicated Core options in each block. Note that these are themed by topic area and Block C modules are pre-requisite for the indicated modules in Block D

Option* = BIMS must select a minimum of one of the indicated (*) modules in block C OR block D (timetable permitting)

Students may select up to two level 3 modules across Blocks C AND Block D. Where space is limited, level 3 students shall have precedence.

Disclaimer: Please note that modules normally require a minimum number of enrolled students in order to run. If this minimum is not achieved, the module may be withdrawn for the relevant academic year.