

## **COURSE MODULES**

### **LEVEL 1.1**

#### **Career & Professional Preparation I**

This module is part of the Education and Career Guidance framework to provide students with the tools and resources necessary for their career and/ or further education. In this first module, students will undergo personal discovery and exploration of industry and career prospects. Students will learn how to plan and set achievable goals in preparation for their future. Students will also learn the importance of passion and professionalism, and basic teamwork and interpersonal skills.

#### **Inorganic & Physical Chemistry**

The module covers the structure of matter, chemical bonding, thermochemistry, chemical equilibria, kinetics, electrochemistry and redox reactions, transition metal chemistry, chemistry of solutions, including acids, bases and buffers.

#### **Mathematics**

This module provides students with a fundamental and analytical knowledge of mathematics, essential for the study of life sciences. The module is designed to equip students with the necessary mathematical techniques to solve biological and chemical problems, as well as to carry out analytical studies in their future work. Topics include analytical geometry, integration, differentiation and differential equations.

#### **Microbiology**

This module introduces a basic understanding of microorganisms and techniques in microbiology. Topics include cell structure and function, classification, viruses and fungi, nutrition, growth and regulation, environmental factors affecting growth, microscopy, staining, size measurement, cell enumeration, media preparation, isolation and cultivation of pure cultures.

### **LEVEL 1.2**

#### **Anatomy & Physiology**

This module equips students with an understanding of the basic principles of homeostatic mechanisms and the anatomy and physiology of the cardiovascular, respiratory, renal, gastrointestinal, neuromuscular, endocrine and reproductive physiological systems that exist in the human body.

#### **Biostatistics**

This module is designed to provide students with basic statistical skills to analyse and interpret simple biological, pre-clinical and clinical data. The basic statistical skills covered include descriptive statistics, data distribution, set sample size, measurement of central tendency, scatter diagram, cluster analysis, simple linear correlation and regression analysis for linear data. The presentation of data in graphical forms using Microsoft Excel covers selection and preparation of different types of graphs, how to write titles and legends and interpretation of results.

#### **Cell Biology & Genetics**

This module explores mammalian cells, tissue and organ systems. Topics include the fundamental chemicals of life, structure and function of cells and organelles, cell cycle and division, study of genes, genetic variation and heredity.

#### **Good Laboratory Practice**

Good Laboratory Practice (GLP) comprises a set of principles that help to define and standardize the planning, performance monitoring, recording, reporting and archiving processes within research institutions and commercial testing laboratories. The module covers standard operating procedures, quality assurance, receipt and handling of samples, monitoring performance of the study, reporting of study results and retention of records. Compliance to GLP regulations will also be covered.

## Organic Chemistry

In this module, students are introduced to the chemistry of hydrocarbons, alcohols, amines, aldehydes, ketones, carboxylic acids and their derivatives. The properties and chemical reactivity of these compounds in relation to the application of chemistry in life sciences will also be discussed.

## COURSE CURRICULUM

Module Name	Credit Units
<b>YEAR 1</b>	
<b>Level 1.1 (24.5 hours per week)</b>	
Career & Professional Preparation I	1.5
Inorganic & Physical Chemistry	6
Mathematics	5
Microbiology	6
Innovation Toolkit ^	4
Sports & Wellness ^	2
<b>Level 1.2 (25 hours per week)</b>	
Anatomy & Physiology	4
Biostatistics	3
Cell Biology & Genetics	6
Good Laboratory Practice	2
Organic Chemistry	6
Critical Thinking & Communication ^	4

### Notes:

^ For more details on Interdisciplinary Studies (IS) electives, please log on to [www.np.edu.sg/is/](http://www.np.edu.sg/is/)

### IS Modules

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## COURSE MODULES

### LEVEL 2.1

#### Applied Microbiology

This is an advanced module in microbiology for second year students and is a continuation of the basic microbiology module. The module focuses on the importance of microorganisms as contaminating agents in the production of foods and pharmaceuticals. The module focuses on the techniques and methodologies involved in the analyses and prevention of microbiological contamination. The module also provides skills and knowledge in Good Manufacturing Practices, food hygiene auditing and in the preparation of a HACCP plan.

#### Biochemistry

This module introduces fundamental and applied concepts in biochemistry. Topics covered include protein chemistry, enzymology, the metabolism of carbohydrates, lipids and proteins. Topics covered during laboratory classes will include spectrophotometric assays, determination of kinetic parameters of enzymatic reactions, thin layer chromatography, dialysis, size exclusion chromatography and polyacrylamide electrophoresis.

### **Career & Professional Preparation II**

This module is part of the Education and Career Guidance framework to provide students with the tools and resources necessary for their further career and/or education. In this module, students will explore basic job search strategies, practise writing effective resumes and cover letters, and learn interview skills. Students will also learn professional and intercultural communication skills to prepare them for a dynamic and diverse workplace.

### **Instrumentation & Analytical Chemistry**

In this module, students learn about the workings of various analytical instruments such as gas liquid chromatography, high-performance and low-pressure liquid chromatography, mass spectrometry and atomic absorption spectroscopy.

## **ELECTIVES**

Choose any 1

### **Aquaculture & Marine Biology**

The applied aspects of biotechnology in the aquaculture of fin and shell fish are introduced. Topics include fish spawning, larval and nursery management, assessment of growth, fish nutrition, diagnosis and treatment of common fish diseases, and aspects of water quality management and analysis. Marine life and ecosystems, marine environmental ecology and marine eco-tourism will also be covered.

### **Biopharmaceutical Processing**

The module covers quality systems in the pharmaceutical and biopharmaceutical industry. Downstream processing involving drying, cell separation technology, chromatography and crystallization will be covered in the module. Students will also be introduced to pharmaceuticals.

### **Food Science & Technology**

The module will cover key topics in modern food science, focusing on key issues which affect the import, production, testing and regulation of processed foods in Singapore. The course will introduce students to local and international food standards, and equip them to interpret data and information presented in the scientific and non-scientific literature. Laboratory classes will focus on the analyses of processed foods.

### **Forensic Science**

This module gives an overview of the techniques employed by crime scene investigators. It equips students with an understanding of forensic and DNA techniques used in criminal investigations and forensic DNA laboratories. Students will gain an understanding of the various aspects of forensic science and its applications. Through case studies, students will have a better understanding of crime scene reconstruction.

## **LEVEL 2.2**

### **Advanced Organic Chemistry**

This module covers basic organic reaction mechanisms like nucleophilic substitution (SN2 and SN1 mechanisms), elimination (E1 and E2 mechanisms), electrophilic addition and electrophilic aromatic substitution, nucleophilic substitution mechanisms (e.g. esterification), reactions of enols and enolates (e.g. alkylation, aldol, Claisen reaction). This module will also cover basic strategies in organic synthesis.

### **Applied Biostatistics**

This module covers advanced statistical skills to analyse and interpret a wide range of biological, pre-clinical and clinical data, and preparation of data for scientific presentation. The statistical skills covered include biological

experiment design, hypothesis testing, quantitative data analysis by parametric and non-parametric methods, qualitative data analysis by Chi-square and Fisher tests, and simple correlation and regression analysis for non-linear data. The scientific presentation section covers how to organise data, prepare and incorporate statistical results on graphs and interpretation of results.

### Cell Culture & Bioprocess Engineering

This module will equip students with strong aseptic techniques and application of cell culture in bioprocess engineering. Topics include biologics, cell lines, media, maintenance of cell cultures, and understanding of bioprocessing. Students will also acquire practical and theoretical knowledge of developing fermentation processes and manufacturing biological products. This module involves understanding basic bioseparation processes for purification of biological products. The module also includes applying bioprocess technology principles to scale-up production, economics, and regulatory considerations of bio-products derived from recombinant organisms, and animal cell culture.

### Molecular Biology

This module covers the fundamentals of molecular biology. Topics include DNA structure and replication, mRNA transcription, protein synthesis, regulation of gene expression in microorganisms, gene mutation and DNA repair mechanisms. In the area of recombinant DNA technology and molecular techniques, students will learn about the isolation of genomic and plasmid DNA, polymerase chain reaction, insertion of target DNA into cloning vector, transformation of E. coli competent cells, identification of recombinant clones, isolation of total RNA and gel electrophoresis. Students will be introduced to basic bioinformatics software for analysis of nucleic acid and protein sequences.

### Immunology

This module introduces the fundamentals of immunology and provides an understanding of how the immune system functions as an integrated defence system against diseases. Topics include an overview of the immune system, innate and adaptive immunity, humoral and cell-mediated immunity, immunization and vaccination, and laboratory immunological techniques. Applications of immunology in overcoming assaults on the immune system and the principles of Hybridoma Technology are also covered.

## COURSE CURRICULUM

Module Name	Credit Units
<b>YEAR 2</b>	
<b>Level 2.1 (26 hours per week)</b>	
Applied Microbiology	6
Biochemistry	6
Career & Professional Preparation II	2
Elective (Choose 1):	
• Aquaculture & Marine Biology	4
• Biopharmaceutical Processing	4
• Food Science & Technology	4
• Forensic Science	4
Instrumentation & Analytical Chemistry	6
Interdisciplinary Studies (IS) elective <sup>^</sup>	2
<b>Level 2.2 (27 hours per week)</b>	
Advanced Organic Chemistry	4
Applied Biostatistics	4
Cell Culture & Bioprocess Engineering	5

Immunology	6
Molecular Biology	6
Interdisciplinary Studies (IS) elective ^	2

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**COURSE MODULES**

**LEVEL 3.1**

**Genomics & Proteomics**

This module provides an insight into the fields of genomics and proteomics. Students will study the functions of genes and their interaction within a genome, the Human Genome Project, genetically modified organisms, gene therapy, protein expression with emphasis on the structure and functions of proteins, methods of purification and analyses of proteins and applications of proteomics.

**Bioinformatics**

This module equips students with essential bioinformatics computational skills. Topics include overview of biological informatics, microarray, protein structure prediction and structural databases, finding conserved motifs and patterns in proteins using online databases, and applications of software tools and resources in gene expression data analysis.

**ELECTIVES**

Choose any 1

**Biomanufacturing Practices**

The module focuses on practices applied in the manufacturing of biological agents such as vaccines, biologic drugs and antibodies. Topics include an overview of biomanufacturing process operations, process scale-up and reactor design and operation.

**Forensic Chemistry**

This module covers chemical analytical techniques used in forensic investigation and equips students with an understanding of methods and principles applied in the forensic chemistry and toxicology laboratories. Students will gain an understanding of the various aspects of forensic chemistry and its applications.

**Food Processing & Safety**

The module will cover principles and techniques used in food industry which include mass and energy balance and their application in food unit operations, size reduction, thermal processing, non-thermal processing and equipment. Under food safety, the proper handling, preparation and storage of food will be explored. Nature of contaminants, safety evaluation of food ingredients and food safety regulations (FDA, AVA) will also be covered.

**Drug Discovery & Clinical Trials**

This module will introduce students to the drug discovery processes, the relationship between activity and functional group chemistry, chemistry of drugs and drug systems. The module also covers the role, composition and authority of Institutional Review Board (IRB), the phases of clinical trials, informed consent, ethical issues in clinical trials, and compliance to regulations.

### Nutrition & Dietetic Science

This module provides students with a basic understanding of nutritional and dietetic concepts, including the role of micro and macronutrients in the diet and their effects on health. Principles of clinical nutrition and dietary requirements for special medical conditions and at different life stages will also be covered. Students will also learn to evaluate the evidence behind the use of common nutraceuticals and functional foods for health benefits as well as the regulations associated with the sales and marketing of such therapies.

## LEVEL 3.2

### 4-Month Internship

Students will undertake a four-month internship and project, giving them opportunities to relate and apply the knowledge acquired in classrooms to work situations and in research. They will be attached to research institutes and companies in various industries such as the pharmaceuticals, healthcare, food, agrotechnology and bioinformatics sectors. Students will also have the opportunity to go on overseas internships.

### Capstone Project

Students will complete a final year research project under the guidance of an academic staff or industry mentor. The Capstone Project can cover any of the key areas in life science research including Molecular Biosciences, Industrial Biotechnology, Food Technology, Aquatic Science & Technology, Environmental Technology and Urban Horticulture & Greenscape.

Students will be able to integrate and apply the knowledge and skills learned from the course. They will be involved in report writing as well as presenting the outcomes of the project in poster and oral presentations. The Capstone Project will further strengthen their writing and communication skills as well as analytical and problem solving skills, thus preparing them for the industry or further studies.

## COURSE CURRICULUM

Module Name	Credit Units
<b>YEAR 3</b>	
<b>Level 3.1 (24 hours per week)</b>	
Bioinformatics	2
Capstone Project	8
Genomics & Proteomics	6
Elective (Choose 1):	
Biomanufacturing Practices	4
Drug Discovery & Clinical Trials	4
Food Processing & Safety	4
Forensic Chemistry	4
Nutrition & Dietetic Science	4
Interdisciplinary Studies (IS) elective ^	2
World Issues: A Singapore Perspective ^	2
<b>Level 3.2 (24 hours per week)</b>	

4-Month Internship	16
Capstone Project	8

Students will take a specific combination of Year 2 and Year 3 electives to fulfil a particular option.

**BIOPHARMACEUTICAL SPECIALISATION OPTION**

- Biopharmaceutical Processing (Year 2)
- Biomanufacturing Practices (Year 3)

**FORENSIC SCIENCE SPECIALISATION OPTION**

- Forensic Science (Year 2)
- Forensic Chemistry (Year 3)

**FOOD SCIENCE SPECIALISATION OPTION**

- Food Science & Technology (Year 2)
- Food Processing & Safety (Year 3)

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