BS365-15 Exploiting Innovation in Biology

23/24

Department
Life Sciences
Level
Undergraduate Level 3
Module leader
Elizabeth Wellington
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

There are many areas of Biology where new developments brought about by advancing knowledge in genomics and proteomics have been explored for commercialisation. Enzymes have long been exploited in a diverse range of industries such as detergent manufacture, food processing and diagnostics. Bacteria are being exploited in environmental clean up (bioremediation) and in clean technology for more environmentally friendly metal and oil extraction. The realisation that microbiomes, the microorganisms that colonise plants, animals and humans in a life-long association, are critically important for immune response, protection against disease and for metabolic well-being has now resulted in exploitation worldwide. Bacteria are also being used for increasing crop yield and in sustainable agriculture for the control of insect pests. This module aims to demonstrate to students how developments are made in the laboratory and then exploited in the environment and in industry. In addition to academic staff within the School a number of experts will contribute to the course to lecture on intellectual property, patent law, new developments in clinical medicine and those resulting from Antarctic exploration. The module will introduce students to ‘cutting edge science’ in the final year and make them aware of how life science research is making a significant contribution to commercial activities globally.

Module web page

Module aims

Students should gain a comprehensive understanding of the principles and practice, and underlying biology and microbiology of key selected areas of exploitation of biological resources. Further lectures will consider the use of bacteria in agriculture for biological control of pests and as inoculants to allow the growth of novel crops. The exploitation of microbiomes will be considered as an emerging technology. This will be followed by a discussion of bioethical aspects of the course such as the use of GM organisms. Students should be able to discuss the role of biology in number of modern industrial processes, to understand the use of enzymes in medical applications for rational drug design, for drug modification, and for drug delivery. In addition to discuss the use of biological systems in the minerals and oil industry as part of the development of clean technology, biosensor development, bioremediation and issues related to climate change. Students will also have an appreciation of the mechanism by which a patent is obtained and some of the processes by which products for use in the medical profession are tested and approved. Furthermore students will gain an appreciation of public health protection in the UK and learn of the latest techniques being used to diagnose disease

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Lectures 1- 6 (Professor Elizabeth M. Wellington)

Exploitation of microbial activity and microbiomes for biological control and the promotion of plant, animal and human health and well-being
Introduction to microbial inoculants; applications to pest control, enhancement of plant growth and manipulation of the plant microbiome and rhizosphere. Advantages and disadvantages of biological control.

Microbes as pesticides. The control of insect and other invertebrate pests. Case studies: Bacillus thuringiensis, baculoviruses and pseudomonads.

Microbial inoculants and manipulation of root microbiomes for promotion of plant growth. The uses of nitrogen-fixing bacteria in symbiotic associations and fungal mycorrhizae colonising plant roots.

The development of GMO microbial inoculants and GMO plants; current and future prospects for use in the environment and problems of biosafety. Review of regulations and comparison of US and EU legislation.

Exploitation of bacteria for microplastic degradation- a case history

What are microbiomes and how has knowledge of the human microbiome been used to explore commercial applications.

Lectures 7-8 Dr Emma Travis, University of Warwick)

New Frontiers: From Genetic Engineering to Synthetic Biology
These two lectures explore the progression from genetic engineering to synthetic biology with discussions of the social and ethical implications. Bioremediation of xenobiotics, recycling waste

and the production of new materials will be explored. Case studies will include phytoremediation of high explosives using genetically switchgrass, biofuel production and one of the first synthetic biology success stories – the production of the anti-malarial artemisinin. The potential future applications of this fast-moving field will also be considered.

Lecture 9 (Dr. Suzy Wood, Warwick Ventures)

Exploitation and innovation in research
How is innovation protected and exploited in Universities? A overview of issues involved in encouraging the close interaction between research and mechanisms of exploitation- a discussion of issues affecting academic research including ethical and commercial considerations. What are the problems and where are the advantages? Reference to specific case studies and some success stories at Warwick University.

Lecture 10-11 (Dr David Elsy, Patent Attorney, Withers & Rogers)
Patenting biological inventions
What is “intellectual property”? What is a patent and what is patentable? Why are patents important? How are patents put together? Examples covering the requirements for novelty, an inventive step: the scope of patents, morality issues, patents relating to genes, plants and animals will be used as illustrations. How is Technology Transfer put into practice?

Lectures 12-15 (Prof. David Pearce, Univ. of Northumbria and British Antarctic Survey)

Exploitation of innovations in Biology by exploration
Introduction to and critical evaluation of how advances in fundamental understanding of biological adaptation to extreme environments coupled with recent technological developments are being exploited for the benefit of the mankind.

i. Enzymes; extremozymes, psychrophiles, thermophiles, enzyme kinetics, co-enzymes and co-factors.

iii Biosensors and public health; remote sensing, defence, diagnosis, epidemiology, control.

iv Climate change; monitoring technology, living with climate change, carbon sequestration.

v Energy; biofuels, feed products, aquaculture, food.

Lectures 16-17 (Professor Peter Hawkey, Health Protection Agency and University of Birmingham)

Research and development in the pharmaceutical and health protection sectors
The two lectures will cover the research and development that led to the discovery of novel products in the pharmaceutical sector followed by a review of diagnostic methods used for infectious diseases in the health protection sector. The selected examples will describe the steps taken to bring these biopharmaceuticals to the market-place. There will be a brief overview of the Public Health England (PHE) and the way it uses modern technology to provide an effective delivery of diagnostic tests. Time permitting; there will be opportunities for discussion on careers and activities in both the pharmaceutical and health protection sectors.

Lectures 18-19 (Professor Richard Napier)

Bioethics
A discussion on the ethical nature of introducing new technologies. Should we simply introduce

GM crops into the environment with no consideration for their impact on existing plant and animal life? Should we be looking to convert food crops into biofuels when there is so much starvation in the world?

Students need to come to these lectures prepared to discuss the issues surrounding the material you have had in the other parts of this module.

Learning outcomes

By the end of the module, students should be able to:

- Discuss the role of biology in a number of modern industrial processes
- Understand the use of enzymes in medical applications for rational drug design, for drug modification, and for drug delivery
- Discuss the use of microorganisms in the minerals and oil industry as part of the development of clean technology
- Discuss the use of bacteria in minerals extraction and in oil and coal desulphurisation
- Consider the use of bacteria in agriculture for biological control of pests and as inoculants to allow the growth of novel crops

Subject specific skills

a. Demonstrate clear understanding of the scientific topic
b. Contain evidence of extended reading and lateral integration of material not covered in the lectures
c. Demonstrate independent thought and deep understanding
d. Specifically answer the set question using information from multiple lectures and sources
e. Be structured and formatted in a way that demonstrates understanding and logical flow
f. Use multiple sources to construct complex scientific arguments and integrating these to build and develop the student's own scientific conclusions.

Transferable skills

1. Critical appraisal of source material
2. Self directed learning
3. Adult learning

Study

Study time

Type	Required
Lectures	19 sessions of 1 hour (13%)
Seminars	1 session of 1 hour (1%)
Total	150 hours

Type	Required
Private study	130 hours (87%)
Total	150 hours

Private study description

130 hrs of self-study and directed reading to prepare for the open book assessment

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time
Open Book Assessment	100%	20 hours

Final assessment for the module will be on open book assessment. This is an essay based assessment consisting of 4 questions- students need to answer 2. The essays cannot be answered using lecture notes alone- students will need to perform background research and essays will need to be fully referenced.

Feedback on assessment

Pastoral meetings with personal tutor

Availability

Courses

This module is Core optional for:

- UIPA-C1L8 Undergraduate Life Sciences and Global Sustainable Development
  - Year 3 of C1L8 Life Sciences and Global Sustainable Development
  - Year 3 of C1LA Life Sciences and Global Sustainable Development: Biological Sciences
  - Year 3 of C1LB Life Sciences and Global Sustainable Development: Ecology
- UIPA-C1L9 Undergraduate Life Sciences and Global Sustainable Development (with Intercalated Year)

    - Year 4 of C1L9 Life Sciences and Global Sustainable Development (with Intercalated Year)
    - Year 4 of C1LC Life Sciences and Global Sustainable Development: Biological Sciences (with Intercalated Year)
    - Year 4 of C1LD Life Sciences and Global Sustainable Development: Ecology (with Intercalated Year)

This module is Optional for:

- UBSA-3 Undergraduate Biological Sciences
    - Year 3 of C100 Biological Sciences
    - Year 3 of C100 Biological Sciences
- Year 3 of ULFA-C1A1 Undergraduate Biological Sciences (MBio)
- Year 4 of ULFA-C113 Undergraduate Biological Sciences (with Placement Year)
- Year 3 of ULFA-C1A5 Undergraduate Biological Sciences with Industrial Placement (MBio)