Taught Masters Module Guide
LEC Taught Masters Module Guide

Please note that this module guide is provided for guidance only and modules are subject to change.

LEC Taught Masters for 2014/15:

- MSc Contamination, Risk Assessment and Remediation
- MSc Ecology and Conservation
- MSc Energy and the Environment
- MSc Environmental and Biochemical Toxicology
- MA/MSc Environment and Development
- MA/MSc Environment, Culture and Society
- MA Environmental Management and Consultancy
- MSc Environmental Science and Technology
- MSc (Research) International Master’s in Environmental Science and Technology
- MSc Resource and Environmental Management
- MSc Sustainable Agriculture and Food Security
- MSc (Research) International Master’s in Sustainable Agriculture and Food Security
- MSc Sustainable Water Management
- MSc Volcanology and Geological Hazards

Disclaimer: The information in this guide has been compiled with great care and attention to detail. All the information is correct at the time of going to press (November 2013). It is important to understand that the provision of courses, modules, facilities and all other arrangements detailed here are reviewed on a regular basis and that we reserve the right to change any details without prior notice.
### Aims and Scope:
To provide an overview of the various components of global environmental change (global warming, ozone depletion, elevated CO₂, tropospheric air pollution) and an in-depth analysis of their biological impacts. The principal focus will be on ecological responses across a range of scales from the organism to the ecosystem. Human impacts are also considered. The subsequent assignment will provide experience of providing a comprehensible written expression of the scientific complexities surrounding issues of significant public concern.

### Syllabus

#### Week 1  
**Climate change: science and politics**  
In this combination of an introductory lectures and workshops, you will have the opportunity to assess data on global warming and its effects on matters of day to day concern. We will also assess treatment of this topic by politicians and the media. The course work assessment will also be introduced this week.  

#### Week 2  
**Climate change effects on human health: impacts, adaptation and mitigation**  

#### Week 3  
**Tropospheric air pollutants and effects on biological systems**  
These lectures will consider air pollutants in the lower atmosphere (troposphere), notably ozone pollution. Tropospheric ozone remains a major element of local and regional pollution, reducing air quality with wide-ranging ecological consequences.

#### Week 4  
**Interacting effects of ozone and other abiotic stresses**  
   a) Plants. These lectures will deal with the interacting effects of different stresses within a changing climate. Impacts of these effects on global food security will be the focus of this section of the course. A case study on the Indo-Gangetic plain will illustrate how both science and social science are needed to help ameliorate the effects of climate on food supply for the region.  
   b) Human Health. Effects of major air pollutants and particulate matter on cardiovascular disease, respiratory problems, skin effects, cancer and artherosclerosis.

#### Week 5  
**Acidifying pollutants: it’s crystal clear, isn’t it?**  
Effects of acidifying pollutants on vegetation and ecosystems

### Learning outcomes
You will obtain a balanced knowledge of the current state of knowledge concerning key elements of global change and the ability to critically assess the available data and less formal information relating to the subject. You will gain experience of preparing concise reports that present complex information in a style accessible to a non-specialist audience. The case study from India will be designed to show how science can be put into practice to help ameliorate the effects of climate change.

### Assessment:
Exam 50%, CWA 50%  

### Details of CWA.
There will be one piece of course work, in which a topic of the student’s choice will be presented in the style of a concise briefing document. A balance is required between effective use of the primary literature and communication in an accessible style, and obtaining this balance forms part of the learning process.

### Recommended learning resources.
For the most part reference will be made to the primary literature and, in some cases, published reviews. All sources will be provided in lectures and materials will be available on-line or as hard-copies.
**Module Number:** BIOL 420  
**Module Title:** FOOD SECURITY

<table>
<thead>
<tr>
<th>Number of weeks:</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Term taught:</strong></td>
<td>L1</td>
</tr>
<tr>
<td><strong>Contact hours:</strong></td>
<td>24</td>
</tr>
<tr>
<td><strong>Learning hours:</strong></td>
<td>150</td>
</tr>
<tr>
<td><strong>Pre-requisites:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Co-requisites:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Credits:</strong></td>
<td>15</td>
</tr>
<tr>
<td><strong>Module organiser:</strong></td>
<td>Professor Bill Davies (WJD)</td>
</tr>
<tr>
<td><strong>Other lecturers:</strong></td>
<td>Guest lecturer(s)</td>
</tr>
</tbody>
</table>

### Aims and Scope

Food security is achieved when all people have access to an adequate supply of safe and nutritious food. Currently there are around one billion people who are inadequately fed and this number is likely to double in the next 30 years. The aim of this module is to describe the food system and the range of issues that ultimately determine who eats what. We address issues contributing to variation in food availability, the access that people have to food and the different ways in which food is utilised. The module will address ways in which crops accumulate biomass and undergo reproductive development. This will allow the consideration of why crop plants are so sensitive to biotic and abiotic stress and why there is so much concern about the effects of climate change on food availability and food prices. The impact of the food production system on the environment is considered and along with the tensions arising from our quest for both food security and energy security. Factors impacting food safety and quality are discussed. The approach to the study of these issues is interdisciplinary in nature. The course takes an international perspective on GFS (Global Food Security).

### Syllabus

#### Lecture sessions

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The interdisciplinary basis of Food Insecurity and the shortage of resources for food production</td>
<td>WJD</td>
</tr>
<tr>
<td>2</td>
<td>A fair and just food system</td>
<td>Guest</td>
</tr>
<tr>
<td>3</td>
<td>Food Production I Food production systems: local and global</td>
<td>WJD/Guest</td>
</tr>
<tr>
<td>4</td>
<td>Food Production II Plant Breeding/Crop Improvement for yielding under drought</td>
<td>WJD</td>
</tr>
<tr>
<td>5</td>
<td>Food safety and quality</td>
<td>WJD</td>
</tr>
</tbody>
</table>

#### Workshop sessions

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Food Security Challenge.</td>
<td>WJD</td>
</tr>
<tr>
<td>2</td>
<td>The Royal Society report on Science for Enhancing Food Production/Foresight Report on Food and Farming.</td>
<td>WJD</td>
</tr>
<tr>
<td>3</td>
<td>Food Systems: factors impacting food availability, access and affordability</td>
<td>WJD</td>
</tr>
<tr>
<td>4</td>
<td>Novel crop and resource management systems</td>
<td>WJD</td>
</tr>
<tr>
<td>5</td>
<td>Biofuels We will explore the potential for biofuel production, the capacity of bioenergy to contribute to meeting global energy demands and the social / ecological implications of replacing produce for energy crops.</td>
<td>WJD</td>
</tr>
</tbody>
</table>

### Learning outcomes

On completion of this module a student should be able to:

- Understand the component parts and the interdisciplinary basis of the food system
- Detail the challenges facing global agricultural production as a result of climate change
- Understanding of the shortage of key resources for food production
- Understand the issues affecting peoples' access to food
- Have some understanding of factors impacting food safety food quality
- Detail the problems posed for plants growing in dry soil, at high temperature and in high ozone concentrations
- Demonstrate how basic plant physiology can inform both plant breeding and agronomy to increase the sustainability of agriculture.
- Familiarity with several current/impending crises in global food security

### Assessment

<table>
<thead>
<tr>
<th>Details of CWA:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A report and presentation on one of the components of the food system (issues underlying the delivery of food security)</td>
</tr>
</tbody>
</table>

### Recommended texts and other learning resources

- Reaping the Benefits. The Royal Society 2009
- Foresight Report on Food and Farming 2011
- Other texts supplied
- Seminars from outside speakers

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2013-14
**PLEASE NOTE: MODULE SUBJECT TO POSSIBLE CHANGES**

<table>
<thead>
<tr>
<th>Module number: BIOL421</th>
<th>Module title: DATA ANALYSIS AND INTERPRETATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weeks: 10</td>
<td>Term taught: L1/2</td>
</tr>
<tr>
<td>Pre-requisites: 'A' level maths or LEC.440</td>
<td>Co-requisites: None</td>
</tr>
<tr>
<td>Contact hours: 40</td>
<td>Learning hours: 150</td>
</tr>
<tr>
<td>Credits: 15</td>
<td></td>
</tr>
</tbody>
</table>

Aims and scope: A full first course in statistics and data analysis from a non-mathematical viewpoint. Covering both parametric and non-parametric methods, up to and including generalised linear models.

Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data types, summaries, graphs, statistics, parameters</td>
<td>tbc</td>
</tr>
<tr>
<td>2</td>
<td>Estimation and testing</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Continuous response with categorical covariate</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Continuous response with continuous covariate</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Continuous response - the general linear model</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Categorical response with categorical covariate</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Sampling strategy and design of experiments</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Discrete binary response: logistic regression</td>
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<tr>
<td>9</td>
<td>Discrete count response: log-linear regression</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Class test.</td>
<td></td>
</tr>
</tbody>
</table>

Practical/workshop

<table>
<thead>
<tr>
<th>Practical/workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As above; no formal practical on weeks 2 (students can continue with the lab from week 1) or 7 (students should be completing CW1).</td>
<td>tbc</td>
</tr>
</tbody>
</table>

Learning outcomes:

On completion of this module a student should be able to: design a sensible experiment or sampling scheme; perform and interpret an exploratory analysis of the data; decide on a sensible statistical analysis, including a choice between parametric and non-parametric testing, if relevant; perform that analysis in SPSS and interpret the results. Students should also be able to realise when the analysis that they need to perform is beyond the materials covered in the course, and that they should therefore consult a statistician.

Assessment: CWA: 70% Module Test: 30%

Details of CWA: Two reports on statistical analyses: CW1 (30%) started in week 5 and due before the lecture in week 8; CW2 (40%) started in week 8 and due at the end of week 10.

Recommended texts and other learning resources:

Fowler Cohen and Jarvis: Practical Statistics for Field Biology (Wks 1-4, 6 only)
Howell: Statistical methods for psychology

2013-14
**Aims and scope:** This module considers the underlying principals of toxicology, and the diverse applications of toxicology from mechanistic considerations to hazard assessment.

**Syllabus**

### Lecture

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Toxicology</td>
<td>FLM</td>
</tr>
<tr>
<td>2</td>
<td>Adverse effects: principals of toxicology</td>
<td>FLM</td>
</tr>
<tr>
<td></td>
<td>Adverse effects: mechanisms of toxicology</td>
<td>FLM</td>
</tr>
<tr>
<td>3</td>
<td>Xenobiotic/Drug design: relevance</td>
<td>FLM</td>
</tr>
<tr>
<td>4</td>
<td>Hazard assessment and <em>in vitro</em> regulatory toxicology</td>
<td>FLM</td>
</tr>
<tr>
<td>5</td>
<td>Cytogenetic endpoints in <em>in vitro</em> regulatory toxicology</td>
<td>FLM</td>
</tr>
<tr>
<td>6</td>
<td>Risk characterisation in <em>in vivo</em> regulatory toxicology</td>
<td>FLM</td>
</tr>
<tr>
<td>7</td>
<td>Bio-distribution and elimination</td>
<td>FLM</td>
</tr>
<tr>
<td>8</td>
<td>Disposition: absorption and distribution</td>
<td>FLM</td>
</tr>
<tr>
<td>9</td>
<td>Disposition: phase I biotransformation</td>
<td>FLM</td>
</tr>
<tr>
<td>10</td>
<td>Disposition: phase II biotransformation</td>
<td>FLM</td>
</tr>
<tr>
<td>11</td>
<td>Environmental cancer causation</td>
<td>FLM</td>
</tr>
<tr>
<td></td>
<td>Metabolic activation of xenobiotics</td>
<td>FLM</td>
</tr>
<tr>
<td></td>
<td>Classes of chemicals that cause cancer</td>
<td>FLM</td>
</tr>
</tbody>
</table>

### Practical/Workshop

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop 1.</td>
<td>Classification and examination of toxicological effects: choose and examine a particular adverse effect</td>
<td>FLM</td>
</tr>
<tr>
<td>Workshop 2.</td>
<td>Bacterial mutagenicity assays: concept and use</td>
<td>FLM</td>
</tr>
<tr>
<td>Practical 3.</td>
<td>Preparation of a clonogenic assay: testing of positive controls</td>
<td>FLM</td>
</tr>
<tr>
<td>Practical 4.</td>
<td>Good laboratory practice: scoring clonogenic assay and written report</td>
<td>FLM</td>
</tr>
</tbody>
</table>

**Learning Outcomes:**

On completion of this module students should be able to:

### Generic

- Appreciate the underlying principals of toxicology i.e. the adverse effects of chemicals of living organisms
- Appreciate the diverse applications of toxicology from mechanistic considerations to hazard assessment
- A strong understanding of the fundamental principals of, and the practical skills required for, state-of-the-art methodologies routinely employed in environmental bio-monitoring and hazard assessment

### Subject Specific

- Identify the three main categories of toxicology and how they inter-connect
- Explain the main underlying principles of *in vitro*/*in vivo* regulatory toxicology and possess a practical working knowledge of important state-of-the-art assays
- A strong understanding of toxicokinetics and toxicodynamics with particular emphasis on biotransformation and xenobiotic actions/interactions
- Appreciate the diverse mechanisms by which different agents may play an important role in cancer causation alongside epidemiological evidence
- Competence in the practical skills required in routine laboratory techniques used in environmental bio-monitoring and hazard assessment

**Assessment:** CWA: 50% Exam: 50%

**Details of CWA:**

1. Written piece of coursework (2,000 word essay delineating a toxic mechanism)

**Recommended texts and other learning resources:**

2. Molecular Toxicology, edited by P. David Josephy and Bengt Mannervik, 2nd edition (publ by OUP)
3. The academic journals *Mutagenesis, Carcinogenesis, Environmental Science and Technology,* and *Environmental Health Perspectives* - all available online
**MODULE NUMBER:** BIOL 432  
**MODULE TITLE:** CONSEQUENCES OF TOXICOLOGICAL EFFECTS

<table>
<thead>
<tr>
<th>Number of weeks: 5</th>
<th>Term taught: M2</th>
<th>Contact hours: 30</th>
<th>Learning hours: 150</th>
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<tbody>
<tr>
<td>Pre-requisites: BIOL431</td>
<td>Co-requisites:</td>
<td>Credits: 15</td>
<td></td>
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</tbody>
</table>

**Module organiser:** Dr FL Martin  
**Other lecturers:**

**Aims and scope:** This module considers the underlying principles of toxicology, and the human health effects of various environmental exposures.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Environmental exposures</td>
<td>FLM</td>
</tr>
<tr>
<td>2</td>
<td>Pesticides: classes and uses</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Routes of exposure and toxic effects I</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Routes of exposure and toxic effects II</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Environmental monitoring</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Air pollution: risks and monitoring</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Toxic effects of air pollutants</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Adverse effects: applications of toxicology</td>
<td></td>
</tr>
</tbody>
</table>

**Consequences of Environmental Exposure**

| 7 | Relevance of epigenetic mechanisms in carcinogenesis |
| 8 | Repair of carcinogen-induced damage |
| 9 | Initiation/promotion/cancer development |
| 10 | Epidemiological observations regarding cancer incidence |

**Practical/Workshop**

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop 1.</td>
<td>The need for cytogenetic assays in the pipeline</td>
<td>FLM</td>
</tr>
<tr>
<td>Practical 2.</td>
<td>Measurement of DNA damage induction in the alkaline single cell-gel electrophoresis (‘comet’) assay or micronucleus assay</td>
<td></td>
</tr>
<tr>
<td>Practical 3.</td>
<td>DNA data analysis and graphical presentation with statistical considerations - written report</td>
<td></td>
</tr>
<tr>
<td>Workshop 4.</td>
<td>Insights into adverse health effects: IR microspectroscopy as a novel technique</td>
<td></td>
</tr>
</tbody>
</table>

**Learning Outcomes:**

On completion of this module students should be able to:

**Generic**
- Appreciate the underlying principals of toxicology i.e. the adverse effects of chemicals of living organisms
- Appreciate the human health effects of various environmental exposures in terms of biotransformation, induction of somatic mutations, neurological impairments, epidemiology etc
- A strong understanding of the fundamental principals of, and the practical skills required for, state-of-the-art methodologies routinely employed in environmental bio-monitoring and hazard assessment

**Subject Specific**
- Identify the three main categories of toxicology and how they inter-connect
- Appreciate the diverse mechanisms by which different agents may play an important role in cancer causation alongside epidemiological evidence
- Describe the mechanisms by which different pesticides exert their adverse effects
- Describe the different potential adverse effects of air pollution (accidental Vs. "fence-line" exposures) in the context of the various classes of such contaminants
- Competence in the practical skills required in routine laboratory techniques used in environmental bio-monitoring and hazard assessment

**Assessment:**  
**CWA:** 50%  
**Exam:** 50%

**Details of CWA:**
1. written practical report

**Recommended texts and other learning resources:**
1) Casarett & Doull’s Toxicology: the basic science of poisons, edited by Curtis D. Klassen, 6th edition (published by McGrawHill)
2) Molecular Toxicology, edited by P. David Josephy and Bengt Mannervik, 2nd edition (published by OUP)
3) The academic journals Mutagenesis, Carcinogenesis, Environmental Science and Technology, and Environmental Health Perspectives - all available online

2013-14
### Module: Using the National Vegetation Classification

**Module Number:** ECOL413  
**Module Title:** Using the National Vegetation Classification

<table>
<thead>
<tr>
<th>Number of weeks: 1</th>
<th>Term taught: Summer</th>
<th>Contact hours: 34</th>
<th>Learning Hours: 150</th>
</tr>
</thead>
</table>

**Pre-requisites:**  
**Co-requisites:**  
**Credits:** 15

**Module organiser:** Dr Carly Stevens  
**Other lecturers:**

#### Aims and scope:
This module aims to provide a thorough grounding in the principles and practice of the vegetation survey including plant species identification, Phase 1 Survey and National Vegetation Classification (NVC). The module will consider the use of NVC for the description and understanding of plant communities and its application for vegetation survey, assessment and monitoring. The module is taught intensively within one week.

#### Syllabus

<table>
<thead>
<tr>
<th>Lecture/workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td><strong>Plant species identification</strong> - Using vegetation keys to identify plant species.</td>
<td>CS</td>
</tr>
<tr>
<td></td>
<td><strong>Phase 1 habitat survey</strong> - conducting phase 1 habitat surveys and mapping vegetation types</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Introduction to the National Vegetation Classification</strong> - An outline of the origin and purpose of the NVC as a systematic and comprehensive survey of the plant communities of natural, semi-natural and major artificial habitats in Britain.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>The NVC survey methodology</strong> - Basic technique of recognising boundaries and homogeneous strands, of locating sample quadrats and recording essential features of the composition and structure of the vegetation and its relationship to the habitat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Using keys to identify plant communities</strong> - Assembling field data into floristic tables, understanding the concepts of frequency and abundance to identify plant communities encountered in the field.</td>
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<tr>
<td></td>
<td><strong>Understanding floristic tables of vegetation data</strong> - Using these results to understand the basic style of phytosociological floristic tables; the concepts of communities and sub-communities; constant, associate, differential and preferential species.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Applications of the NVC for vegetation monitoring and management</strong> - Using the data and results from the above in case studies to demonstrate descriptive and predictive applications of the NVC for vegetation monitoring, management and landscape design.</td>
<td></td>
</tr>
</tbody>
</table>

**Practical**

Several of the above sessions include practical field exercises involving data collection from a range of vegetation types with subsequent analysis, evaluation and interpretation.

#### Learning Outcomes:
On completion of this module a student should be able to:

1. Plan and execute a vegetation survey of a site
2. Identify a range of plant communities
3. Appreciate the complex relationships between vegetation and climate, soils and human impacts
4. Assess vegetation in local, regional and national contexts
5. Understand the potential and limitations of the NVC as a monitoring, management and design tool

#### Assessment:
**CWA:** 100%

**Details of CWA:**
The coursework task is to assess the meaning and quality of data about a site and its vegetation using the taught skills in the National Vegetation Classification

#### Recommended texts and other learning resources:

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2013-14
MODULE NUMBER: ECOL 414  |  MODULE TITLE: HABITAT MANAGEMENT

Number of weeks: 5  |  Term taught: L2  |  Contact hours: 26  |  Learning hours: 150

Pre-requisites:  |  Co-requisites:  |  Credits: 15

Module organiser: Dr Andy Wilby  |  Other lecturers: External Lecturers

Aims and scope:
On this course students will be shown how habitats can be managed for nature conservation through manipulation of species, communities and ecosystems. This will include guidance in the construction of conservation management plans, in which conservation aims are specified, threats identified, and management actions defined, taking into account the dynamic nature of ecosystems and conflicts of interest in land use. The course is largely taught by external lecturers who are directly involved in the application of ecological principles to practical problems.

Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Topics will vary from year to year, according to availability of personnel etc. It is anticipated that topics will include:</td>
</tr>
<tr>
<td>Dr A. Wilby</td>
<td>Introduction. Habitat management planning</td>
</tr>
<tr>
<td>Dr A. Wilby</td>
<td>Ecological principles underlying management</td>
</tr>
<tr>
<td>Dr F.W. Grayson</td>
<td>Grazing and grassland management</td>
</tr>
<tr>
<td>Mr Richard Rhodes</td>
<td>Upland farming and wildlife</td>
</tr>
<tr>
<td>RSPB staff</td>
<td>Conservation of birds and wetland habitats</td>
</tr>
<tr>
<td>Game and Wildlife Conservation Trust staff</td>
<td>Integrating farming and wildlife conservation</td>
</tr>
</tbody>
</table>

Excursions
There will be 3 excursions, in separate weeks, to sites of conservation interest, led by the external contributors and AW.

Workshops
1. Site assessment and management planning
2. Ecological theory and its utility in management planning

Learning Outcomes:

Generic Outcomes - Students should develop skills in:
- scientific writing
- identifying, abstracting and synthesising pertinent information, whilst handling complexity and uncertainty appropriately

Specific Outcomes - On completion of the modules student should be able to:
- discuss the principles underlying the management of habitats for conservation
- describe how those principles can be applied in specific areas
- construct a conservation action plan for a species or site

Assessment: CWA 50%  |  Exam: 50%

Details of CWA:
Students will write a conservation management plan based around one of the site visits.

Recommended Reading
Sutherland, W.J. (2000) The conservation handbook: research, management and policy

2013-14
**Aims and scope:** Conservation of biodiversity is a major goal of humanity, yet justifications for conservation are multifaceted and their relative importance varies among people and societies. Conservation objectives may also come into conflict with economic activity and development. While providing a grounding in the science of biological conservation, this module focuses on some of the key current challenges in conservation biology, where conservation objectives may trade-off against other human objectives. The module highlights our emerging understanding of the complex relationships between biodiversity conservation, the health of ecosystems and human well being. A provisional list of sessions to be covered is as follows:

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Current status of biodiversity and ecosystem services.</td>
<td>Andy Wilby</td>
</tr>
<tr>
<td>2</td>
<td>Biodiversity and human wellbeing</td>
<td>Andy Wilby</td>
</tr>
<tr>
<td>3</td>
<td>Integration of Agriculture and biodiversity conservation</td>
<td>Andy Wilby</td>
</tr>
<tr>
<td>4</td>
<td>Land sparing or wildlife friendly farming?</td>
<td>Andy Wilby</td>
</tr>
<tr>
<td>5</td>
<td>Predator Control as a tool in conservation.</td>
<td>Game and Wildlife Conservation Trust</td>
</tr>
<tr>
<td>6</td>
<td>Shooting and conservation tradeoffs in the uplands.</td>
<td>Andy Wilby</td>
</tr>
<tr>
<td>7</td>
<td>Pollutants and biotic response in aquatic systems.</td>
<td>Ben Surridge</td>
</tr>
<tr>
<td>8</td>
<td>Does tropical deforestation contribute to poverty?</td>
<td>Luke Parry</td>
</tr>
<tr>
<td>9</td>
<td>Wild meat: the impact of hunting on biodiversity</td>
<td>Jos Barlow</td>
</tr>
<tr>
<td>10</td>
<td>Synthesis: Challenges for conservation in the 21st Century</td>
<td>Andy Wilby</td>
</tr>
</tbody>
</table>

**Seminars**

Generally, lectures will be followed by a 50 minute workshop/discussion based on selected readings. Two additional student-led session will cover cross-cutting issues in conservation biology.

**Learning Outcomes:**

**Generic Outcomes:**
1. On successful completion of the module students will be able to:
2. Demonstrate an ability understand and integrate inter-disciplinary information
3. Develop skills of written critique of primary literature from the sciences and social sciences
4. Verbally express informed opinion of conservation issues

**Specific Outcomes:**
On completion of this module a student should be able to:
1. Demonstrate a broad understanding of how humanity benefits from ecosystem services and the primary justifications from conserving biodiversity
2. To discuss in detail several case studies where conservation comes into conflict with other economic and social objectives.
3. To discuss the challenge of conserving biodiversity while meeting the world’s growing demand for food.
4. To display a deep understanding how the developing world will meet the dual challenges of economic development and biodiversity conservation

**Assessment:**

| CWA | 50% | Exam | 50% |

**Details of CWA:**

Students will complete a critical review of the major challenges facing conservation biology in the 21st Century

**Recommended Reading**

*MacDonald D and Service K (2007) Key topics in Conservation Biology. Blackwell*

*Sodhi NS & Ehrlich PR (2010) Conservation Biology for All. Oxford University Press*


2013-14
**Module number:** ECOL 418  
**Module title:** WILDLIFE POPULATION EC eology

<table>
<thead>
<tr>
<th>Number of weeks: 5</th>
<th>Term taught: M2</th>
<th>Contact hours: 35</th>
<th>Learning hours: 150</th>
</tr>
</thead>
</table>

**Pre-requisites:** Some elementary mathematics, e.g. O level maths, or equivalent  
**Co-requisites:** None  
**Credits:** 15

**Module organiser:** Ken Wilson  
**Other lecturers:** none

**Aims and scope:** The aim of this module is to provide students with knowledge of population processes within wildlife ecology. The module takes a step-by-step approach to understanding wildlife population ecology, from the basics up to more complex interactions between species. The practical element of the module includes field, laboratory and modelling assignments. After taking this module, students will appreciate the factors that contribute to population change, be able to construct life tables from birth and death data, and be able to apply quantitative models of population ecology to applied situations. Knowledge of these processes is vital for people working in the fields of conservation or management of natural resources, such as harvesting of fish stocks, infectious disease control, and pest management, examples of which are scattered throughout the module. The module will demonstrate how population processes influence the behaviour of individual animals, populations of individuals, and communities of populations, so showing the importance of wildlife population ecology at all levels.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction: what is wildlife population ecology and how do we study it?</td>
<td>KW</td>
</tr>
<tr>
<td>2</td>
<td>Population growth: from water fleas to blue whales</td>
<td>KW</td>
</tr>
<tr>
<td>3</td>
<td>Life tables I: quantifying survival and death rate - humans, sheep and fruit flies</td>
<td>KW</td>
</tr>
<tr>
<td>4</td>
<td>Life tables II: quantifying reproduction and birth rate - mussels, moose and mice</td>
<td>KW</td>
</tr>
<tr>
<td>5</td>
<td>Density-dependence I: scramble and contest competition - from beetles to grouse</td>
<td>KW</td>
</tr>
<tr>
<td>6</td>
<td>Density-dependence II: intra-specific competition and the route to chaos</td>
<td>KW</td>
</tr>
<tr>
<td>7</td>
<td>Interactions between species I: inter-specific competition - a tail of two squirrels</td>
<td>KW</td>
</tr>
<tr>
<td>8</td>
<td>Interactions between species II: predator-prey interactions - the lynx and the hare</td>
<td>KW</td>
</tr>
<tr>
<td>9</td>
<td>Pests, parasites and pathogens I: biological control, parasitoids and rats</td>
<td>KW</td>
</tr>
<tr>
<td>10</td>
<td>Pests, parasites and pathogens II:: rabies, foot-and-mouth and nematode worms</td>
<td>KW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practical/ workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Collecting population data: small mammal trapping in the field</td>
<td>KW</td>
</tr>
<tr>
<td>2</td>
<td>Mark-release-recapture methods: laboratory practical</td>
<td>KW</td>
</tr>
<tr>
<td>3</td>
<td>Constructing life tables: data collection in the field and Excel practical</td>
<td>KW</td>
</tr>
<tr>
<td>4</td>
<td>Population modelling: computer simulation practical using Populus</td>
<td>KW</td>
</tr>
<tr>
<td>5</td>
<td>Case studies in applied population ecology; poster presentation and workshop</td>
<td>KW</td>
</tr>
</tbody>
</table>

**Learning outcomes:**

On completion of this module a student will be able to:

**Generic**
- appreciate how individual life history decisions determine population level processes
- use quantitative methods and population modelling packages
- resolve applied ecological problems using basic biological information
- summarize complex data using a variety of methods

**Specific**
- demonstrate a knowledge of basic population concepts, such as density-dependence, trade-offs, competition, predation, parasitism, etc.
- generate a life table using demographic (birth and death) data.
- demonstrate a knowledge of the fundamentals of population models, such as the Logistic and Lotka-Volterra models, and appreciate the use of population models in applied ecology

**Assessment:**  
**CWA:** 50%  
**Exam:** 50%

**Details of cwa:**

The module will be assessed through CWA with respect to the following outputs:
- A presentation synthesising a quantitative aspect of wildlife population ecology, demonstrating an ability to use disparate literature sources and to present a coherent story of applied or theoretical interest.

The module will be assessed through examination with respect to the following learning outcomes.
- Appreciate how individual life history decisions determine population level processes.
- Understand the value of quantitative methods and mathematical modelling for making applied management decisions.

**Recommended texts and other learning resources:**
<table>
<thead>
<tr>
<th><strong>MODULE NUMBER:</strong> ECOL419</th>
<th><strong>MODULE TITLE:</strong> WILDLIFE MONITORING TECHNIQUES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of weeks:</strong> 5</td>
<td><strong>Term taught:</strong> M1</td>
</tr>
<tr>
<td><strong>Contact hours:</strong> 38</td>
<td><strong>Learning hours:</strong> 150</td>
</tr>
<tr>
<td><strong>Pre-requisites:</strong> None</td>
<td><strong>Co-requisites:</strong> None</td>
</tr>
<tr>
<td><strong>Module organiser:</strong> Dr Rosa Menendez</td>
<td><strong>Other lecturers:</strong> Dr Jos Barlow, Dr. Ian Hartley, Dr Andy Wilby, Dr Ken Wilson,</td>
</tr>
<tr>
<td><strong>Aims and scope:</strong> The module will teach a range of taxonomically-based field skills that will combine identification, sampling and other methods used to quantitatively monitor or assess populations. Components will include sessions on birds, mammals and invertebrates.</td>
<td></td>
</tr>
</tbody>
</table>

**Syllabus**

<table>
<thead>
<tr>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>The module will have five sections, each delivered with one or two lectures and including a field component in campus or away. Section content will be determined by staff skills and may vary from year to year in relation to availability, but examples of key components include:</td>
<td></td>
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<tr>
<td></td>
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</tr>
<tr>
<td>a) Bird census techniques. Identification of key groups, such as waders or woodland birds using plumage and song.</td>
<td>IH</td>
</tr>
<tr>
<td>b) Mammal census techniques. Small mammal trapping and marking, issues of sample bias, camera traps, indirect methods.</td>
<td>KW</td>
</tr>
<tr>
<td>c) Terrestrial Invertebrate sampling methods. Identification of key taxa to various levels of detail, trapping methods (e.g. pitfall, sweep netting, suction sampling).</td>
<td>RM/AW</td>
</tr>
<tr>
<td>d) Woodland sampling techniques. Measuring woodland structural complexity.</td>
<td>JB</td>
</tr>
<tr>
<td>e) Measuring and representing species diversity (computer based session using EstimateS software).</td>
<td>RM/AW</td>
</tr>
</tbody>
</table>

**Learning outcomes:**

On completion of this module a student will be able to:

- Demonstrate identification skills with the key taxa used on the module
- Identify appropriate sampling methods and apply them in the field
- Demonstrate a knowledge of the fundamentals of sampling bias for different trapping, recording and sampling methods
- Demonstrate how surveys are used at different scales

**Assessment:** CWA: 100%

**Details of CWA:**

1) Field survey proposal (1500 words) (30%)
2) Field survey report (2500 words) (50%)
3) Module test (20%)

**Recommended texts and other learning resources:**

Module title: Flood Forecasting and Flood Risk Management

Number of weeks: 5
Term taught: L2
Contact hours: 30
Learning hours: 150

Pre-requisites: -300 level hydrology module
Co-requisites:

Module organiser: Prof Keith Beven
Other lecturers: - Guest speakers TBA

Aims and scope: To develop the understanding needed in flood risk assessment, flood frequency analysis, flood forecasting and warning, and catchment flood management plans. To apply this understanding to develop a flood risk map.

Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Lecture sessions, one seminar session, one practical exercise / computer lab / presentations each week</td>
<td>Session 1: Introduction to flood risk management: Historical context / Definitions of flood risk / Flood Frequency / Flood Inundation Mapping / Flood Routing / Real-Time Flood Forecasting &amp; Warning / Flood Defence / Flood Management</td>
<td>KJB and Guest Lecturers</td>
</tr>
<tr>
<td>Session 2: Flood Frequency 1: Distributions</td>
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<tr>
<td>Session 3: Flood Frequency 2: Flood Estimation Handbook</td>
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<tr>
<td>Session 4: Flood Frequency 3: Continuous Simulation</td>
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<tr>
<td>Session 5: Flood Routing and Risk Mapping: Theory of Channel Flow</td>
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<tr>
<td>Session 6: Flood Routing: Model Calibration and Uncertainty</td>
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<tr>
<td>Session 7: Real-time flood forecasting and flood warning</td>
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<td>Session 8: Flood defence strategies and reliability analysis</td>
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<td>Session 9: Catchment Flood Management Plans</td>
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<tr>
<td>Session 10: Planning for Climate Change</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Practical/Workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designing instrument network for a flood forecasting system</td>
<td>KJB</td>
<td></td>
</tr>
<tr>
<td>Flood Forecasting in the River Eden: the Carlisle Flood 2005</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Learning Outcomes:

On completion of this module a student will be able to:

Generic Outcomes

- To develop understanding of frequency concepts and prediction uncertainties.
- To develop discussion and presentation skills.

Subject Specific Outcomes

- To develop the understanding needed in flood risk assessment, flood frequency analysis, flood forecasting and warning, and catchment flood management plans.
- To apply this understanding to develop a flood monitoring and forecasting programme.
- To develop knowledge and report on a specific area of flood risk management

Assessment:

CWA: 100%

Details of CWA: Each student will prepare a seminar presentation and report on a specific topic in flood risk assessment.

Recommended texts and other learning resources:

Beven, K J, Rainfall-runoff modelling - the primer, Wiley, 2003
Blazkova, S and Beven, K J, 2004, Flood frequency estimation by continuous simulation of subcatchment rainfalls and discharges with the aim of improving dam safety assessment in a large basin in the Czech Republic, J. Hydrology, 292, 153-172
Faulkner, H, Parker, D, Green, C, Beven, K, 2007, Developing a translational discourse to communicate uncertainty in flood risk between science and the practitioner, Ambio, 16(7), 692-703

2013-14
**MODULE NUMBER: ENV 405**  
**MODULE TITLE: GROUNDWATER RESOURCES AND PROTECTION**

<table>
<thead>
<tr>
<th>Number of weeks: 4</th>
<th>Term taught: M2</th>
<th>Contact hours: 24</th>
<th>Learning hours: 150</th>
</tr>
</thead>
</table>

**Pre-requisites:** Some basic hydrology  
**Co-requisites:**  
**Module organiser:** Prof. A Binley  
**Other lecturers:** Jan Hookey (Environment Agency)

**Aims and scope:** This course aims to introduce the principles of groundwater flow and transport and describe the various approaches for investigating groundwater systems. Challenges facing management of groundwater quantity and quality are outlined. Use is made of computer models to solve practical problems relevant to the water industry.

### Syllabus

**Lecture** | **Title** | **Lecturer**
---|---|---
1 | Groundwater fundamentals | AB
2 | Aquifer properties | AB
3 | Groundwater investigation techniques | AB
4 | Groundwater flow | AB
5 | Well hydraulics | AB
6 | Groundwater flow models | AB
7 | Natural groundwater quality | AB
8 | Groundwater transport | AB
9 | Groundwater transport models | AB
10 | Managing groundwater resources | JH
11 | Groundwater pollution remediation and protection | JH

**Practical/workshop** | **Title** | **Lecturer**
---|---|---
P1 | Groundwater investigation techniques: field visit | AB
P2 | Modelling groundwater flow using PMWIN | AB
P3 | Modelling groundwater transport using PMWIN | AB
P4 | Student presentations | AB

**Learning Outcomes:**

On completion of this module a student will be able to:

- **Generic Outcomes**
  - Numerically evaluate model results
  - Prepare reports for a Head of Section as if working for an organisation such as the Environment Agency

- **Subject Specific Outcomes**
  - List the methods that are widely used for investigating groundwater systems.
  - List the main steps in conducting a pumping test for determination of aquifer formation constants.
  - Apply a specific groundwater model (PWWIN) to a number of problems.
  - State the limitations of models, such as PMWIN, for practical use.
  - Determine values of subsurface flow parameters from experimental data
  - List a range of approaches for protecting and managing groundwater resources.

This will be achieved through lectures and hands-on practical training with a variety of models.

**Assessment:**

- **CWA:** 50%  
- **Exam:** 50%

**Details of CWA:**

One report (40% total assessment) based on the practical exercises.  
One short presentation (10% total assessment).

**Recommended texts and other learning resources:**


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2013-14
Aims and scope:
Catchments are increasingly perceived as complex and highly interconnected systems. This presents significant difficulties for those who manage catchments, but also a range of novel and timely research opportunities. In this context, the module aims to provide students with understanding and practical experience of key research and management challenges facing the future management of catchments. The module will take the Eden catchment as a case study, and draw on the latest land and water management framework, derived from the Water Framework Directive, as a basis for discussion. After analysing this framework and identifying significant challenges, students will use a combination of field, laboratory and data analysis techniques to investigate research questions related to biophysical processes within catchments. These investigations will lead to an appreciation of the limits to current knowledge and the opportunities for future research.

Syllabus
The module will be run as a series of linked project days. The content of the week will provide students with experience of:
- Water resources management and river flow
- Pollutant sources, pathways and impacts in receiving waters
- Assessing morphological conditions in rivers
- Links between land use and sustainable water management
- Interaction with Environment Agency/Water Company/Rivers Trust staff

Learning Outcomes:
On completion of this module a student will be able to:
- analyse management frameworks relevant to sustainable water management, and identify and justify linked research and management challenges that emerge from these frameworks
- apply relevant field, laboratory and data analysis techniques to investigate these challenges, and describe the limitations and potential sources of error in these techniques
- critically appraise the current state of knowledge related to these challenges, and plan and justify future research activities to address gaps in knowledge

Assessment: CWA: 100%
Details of CWA:
A structured report (‘workbook’) with components for the individual project days, site visits, and integrating catchment research and management question

Recommended texts and other learning resources:
Students will be directed towards specific reading during each project day. Useful background material in the general context of the Water Framework Directive and sustainable water management includes:
UKTAG documentation, particularly related to Surface Water Classification Schemes and Environmental Standards, available from: http://www.wfduk.org/
MODULE NUMBER:  ENV.408  
MODULE TITLE: MODELLING ENVIRONMENTAL PROCESSES

Number of weeks: 5  
Term taught: L1  
Contact hours: 30  
Learning hours: 150  

Pre-requisites: None  
Co-requisites:  
Credits: 15  

Module organiser: Dr W Tych  
Other lecturers: None

Aims and scope: Introduction to basic principles and approaches to computer-aided modelling of environmental processes with applications to real environmental problems such as pollutant dispersal in rivers and estuaries, population dynamics etc. The mathematical and statistical aspects of modelling and data analysis are kept to a minimum and the emphasis is on the use of computer-based methods and practical examples.

Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>Scope of the course; Scientific methodology and modelling: Introduction to modelling</td>
<td>WT</td>
</tr>
<tr>
<td>4-6</td>
<td>Approaches to modelling: the role of data and perceptions in the modelling process; the problems of badly defined systems in the context of modelling environmental processes</td>
<td></td>
</tr>
<tr>
<td>7-10</td>
<td>The concept of dynamic system. First order linear systems, with the Nicholson blowfly dynamics and the Aggregated Dead Zone (ADZ) model of dispersion in a river used as practical case studies. Transfer function models, steady state gain and time constant; serial, parallel and feedback connections of first order systems. Block diagram analysis.</td>
<td></td>
</tr>
<tr>
<td>11-15</td>
<td>Second order linear systems with the predator-prey equations and a climate model as practical examples; natural frequency and damping ratio; higher order systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Linear vs. Nonlinear systems - basic introduction</td>
<td></td>
</tr>
</tbody>
</table>

Throughout the course case studies will be used to illustrate the material.

<table>
<thead>
<tr>
<th>Pract/ workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blowfly population modelling and simulation (Matlab/Simulink package)</td>
<td>WT &amp; demonstrators</td>
</tr>
<tr>
<td>2</td>
<td>Aggregated Dead Zone (ADZ) modelling (Matlab/Simulink package)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Predator-Prey population dynamics modelling and Gilliland Climate model</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Modelling river flow</td>
<td></td>
</tr>
</tbody>
</table>

Learning Outcomes:
On completion of this module students should be able to:

Generic
- Communicate with mathematicians and numerical analysts in joint projects involving modelling.
- Understand the way in which simple mathematical concepts can be used to build models of environmental systems
- Be able to individually undertake some simple modelling tasks and to analyse experimental data.

Subject
- Evaluate the principles and problems of computer aided modelling of environmental systems.
- Use contemporary industry standard numerical software to analyse and simulate environmental systems.

Assessment:  
CWA: 50%  
Exam: 50%

Details of CWA:
Coursework assessment is based on practical reports. During the practical computer based sessions the students are guided through specific data analysis tasks closely related to the lecture contents

Recommended texts* and other learning resources:
There are no recommended books since all available literature is designed for more specialist audiences. However the following texts can be useful to the course if read with discretion.
Bennett, R.J., Chorley, R.J. Environmental Systems, Philosophy, Analysis and Control, Methuen 1980*

2013-14
MODULE NUMBER: ENV.412  MODULE TITLE: ENVIRONMENTAL RADIOACTIVITY

Number of weeks: 5  Term taught: M2  Contact hours: 32  Learning hours: 150

Pre-requisites: Basic maths or LEC.440  Co-requisites:  Credits: 15

Module organiser: Dr J. Pates  Other lecturers: none

Aims and scope: The aim is to provide an understanding of the origin and behaviour of natural and artificial radionuclides in the environment. Their detrimental consequences as pollutants for human health and the environment are discussed, as well as the relevant legislation controlling exposure.

Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to radioactivity.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>2</td>
<td>Radioactive decay and ingrowth.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>3</td>
<td>Interactions of radiation with matter.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>4</td>
<td>Human radiation dose &amp; detriment.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>5</td>
<td>The effects of ionising radiation.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>6</td>
<td>Radiation protection in the UK.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>7</td>
<td>Sources of radioactivity in the environment.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>8</td>
<td>The nuclear fuel cycle.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>9</td>
<td>Nuclear waste management.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>10-11</td>
<td>Behaviour of radioactive contaminants in the marine environment</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>12</td>
<td>Case study: Tc-99 in the Irish Sea</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>13-14</td>
<td>Behaviour of radioactive contaminants in the terrestrial environment</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>15</td>
<td>Case study: the Chernobyl accident</td>
<td>Dr Jackie Pates</td>
</tr>
</tbody>
</table>

Practical/Workshop | Title | Lecturer |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Workshops 1-3.</td>
<td>Calculation methods workshops.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>Practical 1.</td>
<td>Radioactive decay and ingrowth.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>Practical 2.</td>
<td>Radiation dose estimation.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>Practical 3.</td>
<td>Radon in homes.</td>
<td>Dr Jackie Pates</td>
</tr>
<tr>
<td>Seminars 1-4:</td>
<td>Impact of radiation on the environment.</td>
<td>Dr Jackie Pates</td>
</tr>
</tbody>
</table>

Learning Outcomes:
On completion of this module students should be able to:

Generic
- Manipulate and solve basic radioactive decay law equations.
- Use a range of standard resources (e.g. Web of Knowledge) to research a problem.
- Prepare reports for different audiences (popular science, review paper).

Subject Specific
- Identify the sources of natural and artificial radioactivity in the environment.
- Explain the main processes by which radionuclides are distributed through the environment.
- Apply the principles of dose assessment to determine the impact of environmental exposure to radioactivity.

Assessment: CWA: 50%  Exam: 50%

Details of CWA:
Review paper (40%), short ‘New Scientist’ style article (10%)

Recommended texts and other learning resources:
Sumner, D. et al. (1994) Radiation Risks. 3rd ed. Tarrogon (DUHSQ)

2013-14
MODULE NUMBER: ENV.431  
MODULE TITLE: POLLUTION MICROBIOLOGY

<table>
<thead>
<tr>
<th>Number of weeks:</th>
<th>Term taught: M1</th>
<th>Contact hours: 27</th>
<th>Learning hours: 150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-requisites:</td>
<td>None</td>
<td>Co-requisites: None</td>
<td>Credits: 15</td>
</tr>
</tbody>
</table>

**Module organiser:** Prof K.T. Semple  
**Other lecturers:**

**Aims and scope:** The course content broadly encompasses the interactions between microorganisms and naturally occurring organic matter and how this relates to the degradation and persistence of environmental pollutants. The mechanisms of organic matter decomposition and pollutant degradation will be discussed in detail, with particular emphasis being placed in environmental systems, particularly that of soil. The course will then move towards the application of these processes in biological treatment of chemically contaminated ecosystems, highlighting the strengths and weaknesses of the processes, using case studies.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture/workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to environmental microorganisms</td>
<td>KTS</td>
</tr>
<tr>
<td>2</td>
<td>Discuss the decomposition of natural compounds</td>
<td>KTS</td>
</tr>
<tr>
<td>3-4</td>
<td>Discuss catabolic processes: biodegradation, mineralisation, biotransformation, co-metabolism and detoxification.</td>
<td>KTS</td>
</tr>
<tr>
<td>5-6</td>
<td>Relate the decomposition of natural compounds to biodegradation of organic compounds.</td>
<td>KTS</td>
</tr>
<tr>
<td>7-11</td>
<td>Discuss pollutant degradation in the environment, highlighting interactions between pollutants and the abiotic and biotic environment and how this impacts on biodegradation. Discuss the concept of bioavailability.</td>
<td>KTS</td>
</tr>
<tr>
<td>12-13</td>
<td>Discuss the microbial degradation of contaminants in both aerobic and anaerobic environments.</td>
<td>KTS</td>
</tr>
<tr>
<td>14-15</td>
<td>Discuss bioremediation of contaminated systems stressing the involvement of microorganisms, focussing on bioremediation</td>
<td>KTS</td>
</tr>
</tbody>
</table>

**Learning Outcomes:**

After completion of the module, the students will be aware of the importance of microorganisms within different ecosystems, considering biotic interactions, nutrient cycling and organic matter turnover. Further, the students will be cognisant of the role of microorganisms in waste treatment systems, how microorganisms adapt to and metabolise man-made chemicals and their role in the assessment and remediation of contaminated land.

At a generic level, the students will be able to critically appraise aspects of the scientific literature, formulating robust scientific arguments. Further the students will gain experience in teamwork as well as planning, researching and implementing a group presentation.

**Assessment:**  

CWA: 50%  
Exam: 50%

**Details of CWA:**

Essay and Oral presentation

**Recommended texts and other learning resources:**

**Main Text:**


2013-14
MODULE NUMBER: ENV.432

MODULE TITLE: CHEMICAL RISK ASSESSMENT

Number of weeks: 5
Term taught: M2
Contact hours: 28
Learning hours: 150

Pre-requisites: None
Co-requisites: None
Credits: 15

Module organiser: Dr Crispin Halsall
Other lecturers: External specialists from environmental consultancies

Aims and scope: This course will aim to give students grounding in the scientific process behind chemical risk analysis. The effect of chemicals in the environment will be introduced with concepts such as dose-response relationships and observed-effect levels, as well as examining modes of entry and routes of exposure to humans, biota and the ecosystem as a whole. A large part of the module will be dedicated to understanding quantitative exposure assessment, with the introduction of fate modelling and the prediction of concentrations in different environmental compartments. Students will also be introduced into current assessment procedures for pesticide/chemical registration and will partake in group practicals/workshops to understand the steps in chemical risk analysis.

Syllabus

Lecture
Title
Hazard, risk and chemical safety.
Chemical legislation & REACH.
Generic risk assessment procedure.
Hazard identification and assessment.
Exposure assessment: modelling chemical transport and fate and an introduction to chemical fugacity.
Risk characterisation: assessing carcinogenic and non-carcinogenic exposure.
QSARs and chemical properties.
Contamination risk of remote environments.
Risk assessment for environmental management.
Ecological risk assessment.
Probabilistic approaches to risk assessment.

Practicals/Workshops
Title
P1 GENECC - basic screening model for pesticide fate in the environment.
P2 CalTOX - Assessing the risk posed by hexachlorobutadiene.
W1 Modelling organic chemical fate in the environment.

Learning Outcomes:
On completion of this module students should be able to:

Generic
• Gain experience with contemporary computer models detailing chemical fate and human/biota exposure primarily for organic chemical contaminants.
• Understand weaknesses and uncertainty in chemical and environmental datasets and how these can shape the outcome of a risk assessment procedure.

Subject Specific
• Gain knowledge on current legislation (EU, UN and US) regarding chemical use and release.
• Perform a chemical risk assessment procedure to assess the risks posed by both carcinogenic and non-carcinogenic chemicals.
• Learn the steps for quantitative exposure assessment for chemical transport and fate in the environment.

Assessment:
CWA: 50%  Exam: 50%

Details of CWA
Write up of the GENECC and CalTOX practical classes (2 pieces)

Recommended texts and other learning resources:

2013-14
**Module Number:** ENV.434  
**Module Title:** Contaminated Land and Remediation

<table>
<thead>
<tr>
<th>Number of weeks: 5</th>
<th>Term taught: L1</th>
<th>Contact hours: 27</th>
<th>Learning hours: 150</th>
</tr>
</thead>
</table>

**Pre-requisites:**  
**Co-requisites:**  
**Credits:** 15

**Module organiser:** Prof K.T. Semple  
**Other lecturers:**

**Aims and scope:** The module will provide students with a broad view of issues related to contaminated land in particular: (a) typical contamination problems; (b) methodologies for assessing the extent and seriousness of contamination; (c) applicability and effectiveness of remediation techniques as a function of contaminant and site conditions.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to contaminated land issues.</td>
<td>KTS</td>
</tr>
<tr>
<td>2.-3.</td>
<td>Legislation on contaminated land.</td>
<td>KTS</td>
</tr>
<tr>
<td>4.-5.</td>
<td>Risk-based approaches to contaminated land assessment.</td>
<td>KTS</td>
</tr>
<tr>
<td>6.-7.</td>
<td>Fate and behaviour of contaminants in the environment</td>
<td>KTS</td>
</tr>
<tr>
<td>8.-10.</td>
<td>Remediation: general concepts.</td>
<td>KTS</td>
</tr>
<tr>
<td>11.-15.</td>
<td>Seminars.</td>
<td>KTS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practical/ workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Site visit</td>
<td>KTS</td>
</tr>
<tr>
<td>2.</td>
<td>Visiting speaker</td>
<td>KTS</td>
</tr>
<tr>
<td>3.</td>
<td>Visiting speaker</td>
<td>KTS</td>
</tr>
<tr>
<td>4.</td>
<td>Visiting speaker</td>
<td>KTS</td>
</tr>
</tbody>
</table>

**Learning Outcomes:**

After completion of the module, the students will be

- aware of the scale of contaminated land in the UK
- appraised of the changes in legislation pertaining to and the processes used to assess the risk associated with contaminated land
- able to scientifically discuss the processes which control the behaviour of chemicals in soil and comment on the processes which may affect remediation.
- able to communicate in an informed manner about methods of assessment and remediation of contaminated land.

At a generic level, the students will be able to critically appraise aspects of the scientific literature, formulating robust scientific arguments. Further the students will gain experience in teamwork as well as planning, researching and implementing a group presentation.

**Assessment:**

- **CWA:** 25%  
- **Presentation:** 25%  
- **Exam:** 50%

**Details of CWA:**

Group presentation and report.  
Sampling and remediation design case study.

**Recommended texts and other learning resources:**


2013-14
MODULE NUMBER: ENV.435  MODULE TITLE: ENVIRONMENTAL TOXICOLOGY

Number of weeks: 5  Term taught: L2  Contact hours: 28  Learning hours: 150

Pre-requisites: None  Co-requisites: None  Credits: 15

Module organiser: Dr C Halsall  Other lecturers: Scientists from CEH, Lancaster

Aims and scope: This course introduces students to aspects of xenobiotic chemicals in the environment; investigating exposure to and effects on biota and humans. Modes of chemical action accompanied by examples of chemical toxicity in the environment will also be covered, including tests and procedures used for regulatory purposes to assess the impact of chemical substances on different types of biota. This course will address chemical behaviour and availability with respect to organism exposure and associated biological responses. The deleterious effects of contaminants will be highlighted, including biomonitoring and bioassays to examine low dose, chronic exposure to chemicals.

Syllabus

<table>
<thead>
<tr>
<th>Lecture/Workshop</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to toxicology.</td>
<td></td>
</tr>
<tr>
<td>Metals and their health effects.</td>
<td></td>
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<tr>
<td>Persistent organic pollutants and toxic equivalents.</td>
<td></td>
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<tr>
<td>Accumulation of organic contaminants in food chains.</td>
<td></td>
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<tr>
<td>Biotic transportation/ transformation and toxic metabolites.</td>
<td></td>
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<tr>
<td>Toxico-kinetics and dose response.</td>
<td></td>
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<tr>
<td>Endocrine disruption.</td>
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<tr>
<td>Biomonitoring and bioassays.</td>
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<tr>
<td>Biochemical effects of toxicants.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practical/workshop</th>
<th>1. Drinking water quality and health.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Modelling the bioaccumulation of a persistent organic pollutant in fish.</td>
<td></td>
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<tr>
<td>4. Tour of CEH: meeting toxicologists at work.</td>
<td></td>
</tr>
</tbody>
</table>

Learning Outcomes:

On completion of this module students will be able to:

**Generic**
- Develop presentation skills through preparation and delivery of a case study on Selected toxins present in the environment.
- Understand how science-led toxicology research shapes regulatory policy concerning the setting of standards for chemical substances in food and water.

**Subject Specific**
- Understand chemical toxicity and methods of assessing toxic responses, including dose-response, biomonitoring and bioassays.
- Learn the routes by which chemicals enter biota and the biochemistry detailing biotic transformation and metabolism.

Assessment:  CWA: 50%  Exam: 50%

Details of CWA:
Oral presentation (30%) and practical write-up (70%).

**Recommended texts and other learning resources:**
Crosby, D. G. Environmental Toxicology & Chemistry (1998)
Wright, D. A. & Welbourn, P. Environmental Toxicology (2002)

2013-14
**Module number:** ENV 441  
**Module title:** GEOLOGICAL HAZARDS

**Number of weeks:** 5  
**Term taught:** L1  
**Contact hours:** 30  
**Learning hours:** 150

**Pre-requisites:** None  
**Co-requisites:** None  
**Credits:** 15

**Module organiser:** Dr Mark W. Hounslow  
**Other lecturers:** Dr. Emily Heath, Dr Mike James

**Aims and scope:** This module is designed for students who wish to understand more about the fundamentals of geological hazards and the processes responsible. The module puts geological hazards in their context and primarily includes issues of prediction, but with linkage to response and preparedness issues. The core of the module addresses the fundamental processes and mechanics of hazard prediction. Specific hazards addressed are seismic-based hazards, slope stability and landslides and volcanic hazards (flank collapse, plumes and pyroclastic flows). It includes case histories of both national and international disasters.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction. Earthquake locations and magnitudes</td>
<td>EH</td>
</tr>
<tr>
<td>2</td>
<td>Earthquake hazards and how faults rupture</td>
<td>EH</td>
</tr>
<tr>
<td>3</td>
<td>Earthquake prediction and forecasting</td>
<td>EH</td>
</tr>
<tr>
<td>4</td>
<td>Seismic risk mitigation and early warning systems</td>
<td>EH</td>
</tr>
<tr>
<td>5</td>
<td>Tsunami hazards</td>
<td>EH</td>
</tr>
<tr>
<td>6</td>
<td>Landslides, overview and fundamentals</td>
<td>MH</td>
</tr>
<tr>
<td>7</td>
<td>Stress and strength of rocks and soils</td>
<td>MH</td>
</tr>
<tr>
<td>8</td>
<td>Stress analysis soils and rocks</td>
<td>MH</td>
</tr>
<tr>
<td>9</td>
<td>Predicting landslides</td>
<td>MH</td>
</tr>
<tr>
<td>10</td>
<td>Scaling issues of Landslides: volcanoes and mountains</td>
<td>MH</td>
</tr>
<tr>
<td>11</td>
<td>The Volcanic hazard</td>
<td>MJ</td>
</tr>
<tr>
<td>12</td>
<td>Volcano monitoring and forecasting</td>
<td>MJ</td>
</tr>
<tr>
<td>13</td>
<td>Rheology of flows and flow runout 1</td>
<td>MJ</td>
</tr>
<tr>
<td>14</td>
<td>Extreme events 1</td>
<td>MJ</td>
</tr>
<tr>
<td>15</td>
<td>Extreme events 2</td>
<td>MJ</td>
</tr>
</tbody>
</table>

**Practical activities**

1) Probabilistic forecasting of earthquakes  
2) Landslide prediction and material properties  
3) Hekla hazards  
4) Fieldtrip to assess the Falls Foot landslide

**Seminars**

Seismic Hazards.  
Stress and fracturing.  
Slope transfer  
Volcanic risk

**Learning outcomes:**

On completion of this module students will be able to:

- Describe and explain the concepts and foundations of geological hazards
- Apply and report on the methods of prediction and mitigation strategies of geological hazards
- Apply simple principles of analysis of slope failure using a variety of natural hazard situations
- Demonstrate and elaborate an understanding of geological processes responsible for the occurrence, recurrence and magnitude of hazards.
- Apply simple prediction scenarios of geological hazard occurrence, using geological data sets.

**Assessment:**  
CWA: 100%

**Details of CWA:**

This is in two parts. The first involves a report on the Dales fieldwork (20%). The second is a consultancy-style report detailing critical assessment of a geological hazard specific to a single case study (80%).

**Recommended texts and other learning resources:**

**MODULE NUMBER: ENV 448**  
**MODULE TITLE: DATA ANALYSIS AND PROGRAMMING SKILLS**

<table>
<thead>
<tr>
<th>Number of weeks: 10</th>
<th>Term taught:</th>
<th>Contact hours: 60</th>
<th>Learning hours: 150</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S1 and S2</td>
<td></td>
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</tbody>
</table>

**Pre-requisites:** Basic numeracy (e.g. Excel), if required  
**Co-requisites:** none  
**Credits:** 15

**Module organiser:** Dr. Włodek Tych  
**Other lecturers:**

**Aims and scope:** The course should provide the students with advanced scientific numeracy skills. The course focuses on data processing and visualisation for use with dissertation work. It includes introductory elements of Matlab and Simulink, currently a de facto visualisation and numerical processing standard. Some comparison to other programming languages, in particular Fortran and C, is provided. The main programming elements are introduced and used in examples: data input, processing, output in numerical and graphical forms, programming tools and structures (loops, conditional statements and other flow control). The course introduces selected principles of dynamic systems analysis such as transfer functions applied to environmental systems in the form of examples and case studies.

**Syllabus:** course consists of 30 2-hour interactive computer based workshops

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

**Learning Outcomes:**  
On completion of the course the student should be able to:

**Generic Outcomes**
- Communicate with programming professionals on a basic level.
- Adapt the obtained MATLAB programming skills to learning of most other programming languages (such as Fortran, C).
- Solve basic data processing problems using MATLAB or other programming languages.
- Recognise the most fundamental features of computer programming languages.
- Use a sophisticated, programmable data presentation and visualisation tool; load, process and save data in numerical and graphical form.
- Describe the way in which simple mathematical concepts can be used to build models of environmental systems.

**Subject Specific Outcomes**
- Design, write, run and debug simple MATLAB programs; with a potential to use MATLAB as a comprehensive programming language
- Relate the concepts of serial, parallel and feedback connections to processes in the environment.
- Formulate Simulink block diagram representations of simple environmental systems.

**Assessment:**  
CWA: 50%  
Module Test: 50%

**Details of CWA:**  
Coursework will include writing brief Matlab scripts based on the scripts used during workshops as well as a brief essay on selected problems of environmental systems modelling linked with these scripts and introduced during lectures/workshops. CW is submitted by the end of week 27. Open book module tests will be taken during week 24 and week 27 (weeks 4 and 7 of the course). They involve writing code snippets related to simple numerical and graphical problems, using both the worked examples from the workshops and the student's coursework.

**Recommended texts and other learning resources:**
- Young, P.C. (editor) (1993) Concise Encyclopaedia of Environmental Systems, Pergamon Press. (Lancaster University Library: 8 copies, classmark DG1 (Y))  

A comprehensive Matlab bibliography is available at: http://www.mathworks.com/support/books/index.php3

2013-14
### Module Title: Volcanic Process Field Course

**Number of weeks:** 1  
**Term taught:** Lent  
**Vacation + Intro seminars in Lent**  
**Contact hours:** 60  
**Learning hours:** 150

**Pre-requisites:** LEC.424 and usually a Geology or similar UG degree  
**Co-requisites:** None  
**Credits:** 15

**Module organiser:** Dr Mike James  
**Other lecturers:** Dr Steve Lane

### Aims and scope
This course will build upon skills acquired during previous geological field courses. During an intensive week-long field course to an active volcanic region students will improve their understanding of many of the complex processes that take place both on the surface and beneath volcanoes. This will be achieved by undertaking detailed fieldwork at key localities of a basaltic volcano (Mount Etna in 2013, but the location may change in subsequent years). Students will also gain experience in hazard analysis and mitigation.

### Syllabus

#### Seminar
Introductory seminars during Lent Term, including a laboratory lava simulation.  
**Lecturer** MJ/SL

#### Fieldwork
This course allows students to improve their theoretical knowledge of volcanic processes and their field skills by studying the evolution of a basaltic volcano. It will be a problem-based learning course in which students will be presented with two levels of problems. The higher level problem (e.g. understanding the plumbing system of a complex volcano or the role of ‘volcano spreading’ or slope instability in the evolution of volcanoes) will occupy the entire course. Lower level problems will be solved at a number of key localities where students will be expected to unravel the processes involved. During the course, students will improve their observational and deductive skills, and they will learn how to work both individually and in small groups. Group discussions and group analysis of data form an essential component of this course.

### Practical / workshop
Most of the relevant hands-on skills will be taught in the field. In addition there will be evening sessions on a range of volcanological topics, as well as theoretical and data interpretation sessions based on imagery of active processes.

### Learning Outcomes:
On completion of this module students will be able to

#### Generic Outcomes
- Use a range of observational, technical, deductive and analytical skills to solve problems in volcanology,  
- Work effectively in groups and as individuals in demanding conditions.

#### Subject Specific Outcomes
- Systematically identify volcanic rocks in the field.  
- Use observations and knowledge of field relationships to reconstruct conditions during the formation of volcanic rocks.  
- Gain a deep understanding of the effusive, explosive and intrusive processes that take place during volcanic eruptions.  
- Recognise the role of regional tectonics, gravitational deformation of the volcano and major slope instabilities on the evolution of basaltic volcanoes.  
- Explain the problems of dealing with volcanic hazards on heavily populated active volcanoes.

### Assessment: CWA: 100%

#### Details of CWA:
Two equally-weighted parts (subject to modification):

1. A write up of the field course; unravelling field relationships at a number of key localities, describing the processes involved in their formation and placing them in context with primary literature.  
2. A hazard assessment project (~2000 words) that covers a realistic future scenario at Mt. Etna. The cwa is designed to test the outcomes above and this is reflected in the marking schemes.

### Recommended texts and other learning resources:

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2013-14
**PLEASE NOTE: MODULE SUBJECT TO POSSIBLE CHANGES**

<table>
<thead>
<tr>
<th>Module number: GEOG400</th>
<th>Module title: Research Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weeks: 10</td>
<td>Term taught: Michaelmas</td>
</tr>
<tr>
<td>Contact hours: 25</td>
<td>Learning hours: 150</td>
</tr>
<tr>
<td>Pre-requisites: None</td>
<td>Co-requisites: Credits: 15</td>
</tr>
<tr>
<td>Module organiser: TBC</td>
<td>Other lecturers: TBC</td>
</tr>
</tbody>
</table>

**Aims and scope:**
This module is designed to provide students with a critical understanding of the research process and the main approaches, methods and techniques which are typically used for research. The module is intended to enable students to undertake their own independent research as part of their Masters degree and to provide a solid foundation for PhD research.

**Syllabus**

**PART 1: KEY ISSUES AND STRATEGIES IN SOCIAL SCIENCE RESEARCH**
- W1 - What is research? Philosophies and approaches in science.
- W2 Using the literature and ethics and
- W3 Designing and managing research projects
- W4 Qualitative evidence
- W5 Quantitative evidence

**PART 2: ACTION LEARNING**
- W6-10 Working in groups (5-6 students) and a staff member you will choose a research topic and design, conduct and report on their research over the 5 week period, supported via weekly tutorials with the staff member.

**Learning objectives:**
On successful completion of this module, students will:
- Be aware of the importance of situating decisions about methods through reference to the way science philosophies and existing literatures shape research design;
- Be able to explain a range of ethical issues and dilemmas associated with research and ways of managing these issues and dilemmas;
- Be aware of ways of using secondary data to develop original research;
- Have knowledge of a range of qualitative and quantitative research methods and the considerations that have to be made when deciding whether to use the methods, when executing the methods and when analysing and disseminating data;
- Be capable of designing, executing, analysing and disseminating their own research projects in a way that results in aims and objectives being effectively fulfilled.

**Assessment:**
CWA: 100%
4000 word group report outlining the research problem, ethical issues and approaches, key literature, methods, findings and conclusions (50%)
2000 word individual ‘retrospective’ research proposal.

**Details of CWA:**
This module is assessed by two pieces of coursework. An group report on a miniis required that sets out and justifies the way you would approach the issues covered in the module in the context of an exemplary research project

**Key texts and other learning resources:**
- http://www.bbc.co.uk/programmes/b01b1ljm (compulsory listening)
Module number: GEOG410  
Module title: Perspectives on Environment and Development

<table>
<thead>
<tr>
<th>Number of weeks: 10</th>
<th>Term taught: Michaelmas</th>
<th>Contact hours: 25</th>
<th>Learning hours: 150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-requisites: None</td>
<td>Co-requisites:</td>
<td>Credits: 15</td>
<td></td>
</tr>
</tbody>
</table>

Module organiser: TBC  
Other lecturers: TBC

Aims and scope:
This module aims to provide a theoretical foundation for the study of development and the environment from a geographical perspective. As such, it will focus on understanding the ways that scholars have brought together development theory with the analysis of nature-society relations in the majority (i.e., ‘developing’) world. The intent of the module is to provide students with a critical understanding of the evolution of contemporary development discourses, and new ways of thinking about the relationships between environment and development. Some of the key topics that will be discussed are: theories of development, ecosystem services, property rights and the commodification of nature, biotechnology.

Syllabus

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
<td>To be advised</td>
</tr>
</tbody>
</table>

Learning objectives:
The learning outcomes for this module revolve around the acquisition of necessary academic skills, and the acquisition and development of particular kinds of specialised knowledge. In relation to the former category, students completing this module will:

- Acquire advanced skills for developing a reasoned arguments by evaluating, interpreting and providing a critique of complex evidence;
- Understand the relationship between theory and practice, both in a ‘development’ context and in the formulation and conduct of academic research;
- Begin to develop an appropriate academic writing style and method;
- Learn to critique and comment on development-and-environment scholarship, both in the written word and in conversation.

In relation to the development of specialised knowledge relating to development and environment, students will become familiar with:

- A range of theoretical arguments about development, from modernisation theory to sustainable development to post-development;
- Geographical approaches to the study of nature and society, including cultural ecology and political ecology;
- New themes and considerations in the geography of development.

Assessment: CWA: 100%

Details of CWA: This course is assessed by a 5000 word essay.

Key texts and other learning resources:
Reading list and key texts will be supplied at the first lecture

2013-14
Aims and scope:
This module introduces students to the fundamental principles of Geographical Information Systems (GIS) and Remote Sensing and shows how these complimentary technologies may be used to capture/derive, manipulate, analyse and display different forms of spatially-referenced environmental data. The module is highly vocational with theory-based lectures complimented by hands-on practical sessions using state-of-the-art software (ArcGIS & ERDAS Imagine).

Syllabus
The following topics will be covered in lectures:
- Geoinformatics - definitions, components and the nature of spatial data
- Principles of RS: physical basis, sensors, platforms and systems
- Applications of RS
- Principles of GIS
- Vector GIS
- Geoinformatics project design
- Raster GIS and spatial modelling
- Data Integration and Metadata

The following topics will be covered in practicals:
- Getting to know ArcMap (ArcGIS)
- Building a GIS database
- Exploring multispectral data and radiometric enhancement (ERDAS)
- Spatial enhancement and image rectification (ERDAS)
- Spectral enhancement, classification and data fusion (ERDAS)
- Landsat 7, Data Preparation and Supervised Classification (ArcGIS/ERDAS)
- Data Integration (ArcGIS)
- Raster analysis: Simple Map Overlay (ArcGIS)
- Cartography
- Project design

Learning objectives:
On successful completion of this module a student will gain:
- An understanding of the fundamental principles and applications of GIS, RS and spatial modelling;
- An appreciation of the strong linkages between the above disciplines and their fusion to create meaningful spatially-referenced environmental information;
- An appreciation of applications of geoinformatics as reported in the scientific literature;
- Training in the use of advanced software packages such as ArcGIS and ERDAS Imagine;
- Project management skills through completion of a geoinformatics project.

Assessment: CWA: 100%
Details of CWA:
1 x 2500 word review of the geoinformatics literature on a theme (ideally) linked to scheme of study (50%). 1 x 2500 fully-illustrated project report (50%) based on use of ArcGIS and/or ERDAS Imagine. Further details of course work will be given in the first lecture.

Key references:

Key journals:
Transactions in GIS
International Journal of Geographic Information Systems
Remote Sensing of the Environment
Applied Earth Observation and Geoinformation
Journal of Applied Remote Sensing
<table>
<thead>
<tr>
<th>Module number: GEOG414</th>
<th>Module title: ENVIRONMENTAL MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weeks: 10</td>
<td>Term taught: Michaelmas</td>
</tr>
<tr>
<td></td>
<td>Contact hours: 25</td>
</tr>
<tr>
<td></td>
<td>Learning hours 150</td>
</tr>
<tr>
<td>Pre-requisites: None</td>
<td>Co-requisites:</td>
</tr>
<tr>
<td></td>
<td>Credits: 15</td>
</tr>
<tr>
<td>Module organiser: Dr Nigel Watson</td>
<td>Other lecturers:</td>
</tr>
</tbody>
</table>

**Aims and scope:**
This module is designed to provide students with a critical understanding of key concepts, principles, tools and techniques for the management of natural resources and the environment. Particular attention is given to the challenges of dealing with complexity, change, uncertainty and conflict in the environment and to the different management approaches which can be deployed in ‘turbulent’ conditions. The following topics will be covered in the ten 2.5 hour sessions.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Planning and Management in Turbulent Environments</td>
<td>NMW</td>
</tr>
<tr>
<td>Futuristic Approaches and Methods</td>
<td>NMW</td>
</tr>
<tr>
<td>Ecosystem-Based Management</td>
<td>NMW</td>
</tr>
<tr>
<td>Uncertainty and Adaptive Environmental Management</td>
<td>NMW</td>
</tr>
<tr>
<td>Public Participation and Partnerships</td>
<td>NMW</td>
</tr>
<tr>
<td>Utilizing Local Knowledge</td>
<td>NMW</td>
</tr>
<tr>
<td>Social Learning</td>
<td>NMW</td>
</tr>
<tr>
<td>Resolution of Environmental Disputes</td>
<td>NMW</td>
</tr>
<tr>
<td>Implementation of Resource and Environmental Policy</td>
<td>NMW</td>
</tr>
<tr>
<td>Evaluation of Resource and Environmental Policy</td>
<td>NMW</td>
</tr>
</tbody>
</table>

**Learning objectives:**
On successful completion of this module, students will:
1. Have a critical appreciation of the nature of resource and environmental management;
2. Be critically aware of the underlying characteristics and challenges associated with specific contemporary environmental problems;
3. Have in-depth knowledge of a range of different approaches and strategies which may be used for the management of natural resources and the environment;
4. Be able to critique current environmental management policies and practices, and be able to develop constructive proposals for future public policy.

**Assessment:**
CWA: 100%

**Details of CWA:**
This course is assessed solely by coursework. Each student is required to complete two pieces of assessed work, each of which should be approximately 2,500 words in length.

**Key texts and other learning resources:**


2013-14
Module number: GEOG416

Module title: Environmental Auditing

Number of weeks: 10  Term taught: Lent  Contact hours: 25  Credits: 15

Pre-requisites: None  Co-requisites: None

Module organiser: Dr Nigel Watson  Other lecturers:

Aims and scope:

This module is designed to provide students with a basic understanding of the principles, methods and practices of environmental auditing. The function of an environmental audit will be reviewed, along with the different types and methods for gathering audit evidence. Key environmental legislation affecting organizations in the UK is reviewed, along with the use and design of Environmental Management Systems (EMS) and also ISO standards for auditing and EMS. The module includes a practical auditing exercise, a written test and additional course work.

The following topics will be covered in the ten 2.5 hour sessions:

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to environmental auditing</td>
<td>NMW</td>
</tr>
<tr>
<td>2.</td>
<td>Gathering evidence and assessing impacts</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>EU environmental policy</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>UK environmental law and regulation</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Origins and elements of EMS; EMS auditing</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Types and sources of contaminated land</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Methods of remediation</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Pre-audit preparation</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>On-Site audit exercise</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Audit reporting</td>
<td></td>
</tr>
</tbody>
</table>

Learning objectives:

On successful completion of this module, students will:
1. Know about the origins, principles and methods of environmental auditing;
2. Understand how to successfully design, conduct and report on an environmental audit or review;
3. Have developed organisational and interpersonal skills appropriate for environmental auditing;
4. Be aware of key EU and UK environmental policy, legislation and regulations;
5. Understand the principles of environmental management systems;
6. Have a basic understanding land contamination and methods of remediation;
7. Have gained practical experience of undertaking and environmental audit as part of a team;
8. Be aware of the professional standards and guidelines applicable to environmental auditing in the UK.

Assessment: CW 70% (20+50); End-of-module test 30%

Key texts and other learning resources:


2013-14
**PLEASE NOTE: MODULE SUBJECT TO POSSIBLE CHANGES**

<table>
<thead>
<tr>
<th>Module number: GEOG421</th>
<th>Module title: Sustainable Water Management: Concepts, Governance and Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weeks: 10</td>
<td>Term taught: Michaelmas</td>
</tr>
<tr>
<td>Contact hours: 25</td>
<td>Learning hours: 150</td>
</tr>
<tr>
<td>Pre-requisites: None</td>
<td>Co-requisites: Credits: 15</td>
</tr>
<tr>
<td>Module organiser: Lisa Ficklin</td>
<td>Other lecturers:</td>
</tr>
</tbody>
</table>

**Aims and scope:**
The module aims to develop understanding about key concepts, debates and policies in the governance and practice of sustainable water management in the UK. This will include developing an ability to apply such understanding to the analysis of examples of sustainable water management and assess the strengths and weakness of particular policy approaches. Please note each week the sessions are organised around activities that are based on core readings students are expected to do.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Part 1 Concepts of sustainable water management</td>
<td>Lisa Ficklin</td>
</tr>
<tr>
<td>2</td>
<td>What sort of resource is water?</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>How is the concept of sustainability applied in water management?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>What does water governance mean?</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>The Water Framework Directive</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Part 2 - Governance and practice</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Catchment Management and Water Quality</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Flood Risk Management</td>
<td></td>
</tr>
<tr>
<td>9 and 10</td>
<td>Water resource management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drought and demand side management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Student presentations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Part 3 - Case studies</td>
<td></td>
</tr>
</tbody>
</table>

**Learning objectives:**
On successful completion of this module, students will:
* know about key concepts, debates and policies through study of the literature on the governance and practice of sustainable water management
* be able to analyse case studies in sustainable water management and assess the strengths and weakness of particular policy approaches
* have developed an ability to engage in policy analysis and evaluation for sustainable water management.
* have developed and practised the skills of working in groups, critically evaluating research on sustainable water management, undertaking presentations and academic writing

**Assessment:**
CWA: 100%

**Details of CWA:**
This course is assessed by two pieces of coursework: one essay (70%) and a piece of group work (30%)

**Key texts and other learning resources:**
Each week four readings are set - these may be a combination of articles, book chapters or policy documents. There is no single core text. Here are some examples:
**Module Number:** GEOG 422  
**Module Title:** Disaster Management

<table>
<thead>
<tr>
<th>Number of weeks: 10</th>
<th>Term taught: Lent</th>
<th>Contact hours: 20</th>
<th>Learning hours: 150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-requisites: none</td>
<td>Co-requisites: none</td>
<td>Credits: 15</td>
<td></td>
</tr>
</tbody>
</table>

**Module organiser:** Professor Ian Marshall  
**Other lecturers:** none

**Aims and scope:** The module introduces students to important aspects of disaster management in a wide variety of geographical contexts. The module provides a critical appreciation of: (i) the processes involved in natural disaster events (including those that occur after any environmental initiator) and (ii) the assessment of economic, social and environmental impacts and then applies this appreciation to the top level design and implementation of effective hazard management measures.

The module will examine the impacts of hazard events with respect to the Third World and the developed countries particularly the UK and Western Europe, and will do so at a variety of scales from the local to the multi-national. Students will be introduced to different approaches to the analysis of hazard. The role of planning will be critically examined both as a means of mitigating hazard directly and as a tool for highlighting areas where more dynamic mitigation measures such as raising community awareness, improving transport and communications infrastructure, or installing warning systems. Alternative styles of management will be assessed for their potential applicability in a range of specific case study areas.

**Syllabus**

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of Hazard and risk (lecture + discussion)</td>
<td>Professor Marshall</td>
</tr>
<tr>
<td>2</td>
<td>Introduction to full range of natural disasters, associated socio-technical hazards and their management (presentations/discussion)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Develop understanding of large uncertainties in hazard information sources (seminar with discussion)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Application of hazard estimation to specific sites (presentations and discussion)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Costs, benefits and failures of management measures (lecture + discussion)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Detailed investigation of existing management at specific sites (presentations and discussion)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Designing management measures (Group exercise)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Proposing additional management measures (presentations/discussion)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Global hazard management and climate change (lecture/discussion)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Convincing planners and managers (lecture and discussion)</td>
<td></td>
</tr>
</tbody>
</table>

**Learning outcomes:**

On completion of this module a student should be able to:

- describe the principal causes of environmental hazard, in the UK, Europe and elsewhere;
- understand how hazard affects areas economically, socially, culturally and environmentally;
- understand the social, spatial and temporal interactions inherent in hazard;
- appreciate the difficulties and effects of planning for hazard at different scales; appreciate the limitations of purely engineered approaches to disaster management;
- apply their knowledge (from various disciplinary backgrounds) to the construction of clear and cogent arguments (in text and orally through the presentations, debates in class and written coursework); that use case-study and statistical materials effectively, and can form the basis of convincing proposals.

**Assessment:** CWA: 100%

**Details of CWA:**

The module is assessed entirely by coursework. Students are required to write 4 presentations;

- Introduce a hazard type, typical management measures associated with it and their effectiveness (wk 2)
- Assess in detail the hazards associated with 3 named hazard areas (wk 4)
- Discuss existing management measures for a specific hazard area in detail (wk 6)
- Propose and motivate new management measures for 3 named hazard areas facing similar hazards (wk 8)

and write a 2500 word Proposal (including high level cost/benefit analysis) for additional management measures that could be adopted in a current hazard situation.

**Recommended texts and other learning resources:**


Students are expected to obtain a copy, and read it during the first 2 weeks.

Additional references will be drawn from the web as required.
MODULE NUMBER: LEC.422 | MODULE TITLE: DATA ASSIMILATION AND INTEGRATION

<table>
<thead>
<tr>
<th>Number of weeks: 5</th>
<th>Term taught: M2</th>
<th>Contact hours: 30</th>
<th>Notional hours: 150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-requisites: Elementary maths, equivalent to LEC.440, familiarity with Microsoft Excel</td>
<td>Co-requisites:</td>
<td>Credits: 15</td>
<td></td>
</tr>
<tr>
<td>Module organiser: Dr Mike James</td>
<td>Other lecturers: Prof. Ian Marshall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Aims and scope:** Current approaches to cutting edge research in the environmental sciences are highly dependent on digital data, and a wide variety of data types and a large quantity of information can now be delivered relatively easily. This module aims to teach the fundamentals of accessing, annotating, analysing and interpreting digital data from a variety of sources, in an integrated methodology. The data manipulation skills and awareness of available tools to maximise the utility of heterogeneous digital data will be developed. Everyday problems in data collection, both avoidable and unavoidable will be demonstrated, together with annotation techniques that minimise their impact. The strengths and weaknesses of current tools for data mining and visualisation will be presented and discussed. Data from a wide range of sources will be critically assessed for quality, accuracy and utility for environmental applications. Datasets from across the environmental sciences will be used throughout the course and the techniques and benefits of integrating different data streams illustrated.

**Syllabus**

<table>
<thead>
<tr>
<th>Week</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Remote sensing and georeferencing</td>
<td>M.J.</td>
</tr>
<tr>
<td></td>
<td>data availability, source system properties, measurement tradeoffs, analysis tools including those for orthorectification, processing multi/hyperspectral products, data mining and visualisation, data users, commercial applications and restrictions</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Time series</td>
<td>M.J.</td>
</tr>
<tr>
<td></td>
<td>tools and techniques for collection, analysis, visualisation and interpretation of time series data with a particular focus on issues requiring annotation, including non-stationarity, long range dependency, missing data, appropriate measurements and instrumentation, automation, large data volumes and real-time systems</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Ground-based techniques</td>
<td>M.J.</td>
</tr>
<tr>
<td></td>
<td>oblique image and laser scan data, hand-held devices, cost versus accuracy, sensors and sensor networks, analysis and manipulation tools</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Multi-scale consilience</td>
<td>I.M.</td>
</tr>
<tr>
<td></td>
<td>combining evidence from disparate sources and observation types to deliver best possible understanding of spatial and temporal issues at all scale, software and hardware requirements and future research</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Historical and other data sources</td>
<td>M.J.</td>
</tr>
<tr>
<td></td>
<td>integration of historical and process-based approaches, accuracy and annotation issues, citizen-science and multi-scale integration, tools for handling long term datasets, historical data and non-conventional sources</td>
<td></td>
</tr>
</tbody>
</table>

**Learning outcomes:**

On completion of this module students will be able to:

**Generic**
- Work effectively within a small team
- Identify weaknesses in observations and data collection
- Analyse data and communicate results
- Use a range of standard information resources to research a problem
- Use a wide range of informatic techniques

**Subject Specific**
- Identify and overcome difficulties in the analysis of real and incomplete datasets
- Define metadata requirements for specific data types
- Assess the applicability of non-standard data sources
- Appropriately combine results from disparate datasets
- Understand the strengths and weaknesses of a range of observational techniques
- Make appropriate use of state of the art data mining and visualisation tools

**Assessment:** CWA: 100%

**Details of CWA:**
- Three short written seminar/practical reports (20% each)
- A written, critical analysis, covering one topic area or case study (40%)

**Recommended texts and other learning resources:**

**Module Number:** LEC 424  
**Module Title:** Physical Volcanology

<table>
<thead>
<tr>
<th>Number of weeks:</th>
<th>Term taught:</th>
<th>Contact hours:</th>
<th>Learning hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>M</td>
<td>35</td>
<td>150</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-requisites:</th>
<th>Co-requisites:</th>
<th>Credits:</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEC.440 if no A-level maths</td>
<td>None</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module organiser:</th>
<th>Other lecturers:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steve Lane</td>
<td>HT, LW, JSG</td>
</tr>
</tbody>
</table>

**Aims and scope:** This module aims to provide knowledge of volcanoes and volcanic systems. Its foundations are an understanding of the properties and behaviour of volcanic materials gained through laboratory, theoretical and field study. The module emphasizes the widely-applicable physical and chemical processes that occur during volcanic activity, including variations in solubility, rheology, phase, density and permeability. The interaction of volcanic processes with the biosphere, atmosphere and hydrosphere are discussed. The products of volcanism, together with the hazard and benefits to life on Earth are studied.

**Syllabus** (may be subject to change)

<table>
<thead>
<tr>
<th>Week</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Physical properties of magma 1.</td>
<td>HT</td>
</tr>
<tr>
<td>2</td>
<td>Physical properties of magma 2.</td>
<td>HT</td>
</tr>
<tr>
<td>3</td>
<td>Field Volcanology: Ancient volcanism field day.</td>
<td>HT/JSG</td>
</tr>
<tr>
<td></td>
<td>Explore a lava dome erupted c. 400 Ma ago that now forms Haystacks at the head of Buttermere in the English Lake District.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Modelling Volcanoes 1: Exploring volcanic processes using laboratory experiments.</td>
<td>SJL</td>
</tr>
<tr>
<td>5</td>
<td>Laboratory practical; rock hand specimen textures.</td>
<td>HT</td>
</tr>
<tr>
<td>6</td>
<td>Plumes and ash.</td>
<td>JSG</td>
</tr>
<tr>
<td>7</td>
<td>Laves and domes.</td>
<td>SJL</td>
</tr>
<tr>
<td>8</td>
<td>Non-Earth planetary volcanism 1.</td>
<td>LW</td>
</tr>
<tr>
<td>9</td>
<td>Non-Earth planetary volcanism 2.</td>
<td>LW</td>
</tr>
<tr>
<td>10</td>
<td>Modelling Volcanoes 2: Exploring volcanic processes using calculations and computers (assessment).</td>
<td>SJL</td>
</tr>
</tbody>
</table>

**Subject specific learning outcomes**

On completion of this module students will be able to:
- Understand a range of broadly-applicable physical and chemical principles.
- Recognise different types of volcanic activity.
- Understand why volcanoes behave in different ways.
- Recognise volcanism as present on many solar-system bodies.

**Generic learning outcomes**

On completion of this module students will be able to:
- Work both independently and as part of a team on exercises out-of-doors and in the laboratory.
- Use numerical and written skills.
- Access and use the primary literature.

**Assessment:**

<table>
<thead>
<tr>
<th>Details of CWA:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWA: 100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommended texts and other learning resources:</th>
</tr>
</thead>
</table>

Primary publications recommended during the module and available from Moodle.

2013-14
**Module title:** Environmental Sampling and Analysis for Trace Organics

**Number of weeks:** 5

**Term taught:** Lent 1

**Contact hours:** 25

**Learning hours:** 150

**Pre-requisites:** A-levels math and chemistry

**Co-requisites:**

**Credits:** 15

**Module organiser:** Dr Andy Sweetman

**Other lecturers:**

Aims and scope: This module is designed to provide knowledge about analytical techniques used to obtain environmental chemical data. This will prepare students for their MSc thesis research or for a professional career in research, management or policy where analytical techniques are used or data from these techniques need to be interpreted. Particular attention is paid to the entire sampling-analytical system and the fundamentals of common analytical techniques in environmental analysis like mass spectrometry and chromatographic techniques. Further considerations include the quality of the analytical results, statistical interpretation etc. Lectures on organic analytical chemistry theory are complemented with practical laboratory exercises in small groups working in our LEC research laboratories. The students will be given hands-on opportunities familiarize with both classical and instrumental methods usually employed in analytical chemistry.

### Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
</table>
| 1-3     | Basics of Environmental Sampling and Analysis:  
• Concentration units, accuracy, precisions, calibration curve, etc.  
• Essential of Environmental statistics  
• Knowledge of Environmental regulations | Andy Sweetman |
| 4-6     | Environmental Sampling Techniques  
• Environmental Sampling design  
• Sampling matrices and analytes  
• Technique for sampling various Media: practical approaches and tips. | Andy Sweetman |
| 7-9     | Methodology and quality assurance/quality control of environmental analysis.  
• Selection of analytical methods based on target compounds  
• Field quality assurance/quality control  
• Analytical quality assurance/quality control | Andy Sweetman |
| 10-12   | Fundamentals of sampling preparation for environmental analysis (Lecture+practicals)  
• Overview of sampling preparation  
• Extraction for SVOC and non-VOC from liquid of solid matrices (or samples)  
• Post-extraction and clean-up of organic compounds  
• Sampling preparation for VOC. | Andy Sweetman |
| 13-15   | Chromatographic methods for environmental Analysis (lectures+practicals)  
• Introduction to chromatography  
• Instruments for chromatographic methods (GC, LC, HPLC)  
• Common detectors for chromatography  
• Applications of chromatographic methods in Environmental analysis  
• Quantification and calibration curve | Andy Sweetman |

**Learning outcomes:**

At the end of this module the students should:
1. have a good knowledge of the organic chemistry related to the chemicals in the environment and their fate
2. have an understanding of the theory of sampling preparation for environmental analysis and the principles and the operation of some of the major environmental analytical techniques
3. be aware of current issues in environmental analytical chemistry

**Assessment:**

| CWA: 50% | Exam: 50% |

Details of CWA:
Write a detailed laboratory report (1500 words) following the laboratory practical (35%). Write an essay describing analytical procedures and technique used to analyze a given group of target chemicals (15%)

Recommended texts and other learning resources:


Any Problems? If you encounter any problems during the course please contact Andy Sweetman (a.sweetman@lancaster.ac.uk).
### Module title: Environmental Applications of Isotope Geochemistry

**Number of weeks:** 10  
**Term taught:** L1  
**Contact hours:** 30  
**Learning hours:** 150  
**Credits:** 15

**Pre-requisites:** LEC.440 or A-level Maths  
**Co-requisites:** None

**Module organiser:** Greg Holland  
**Other lecturers:** Jackie Pates

**Aims and scope:** This module will focus on how different isotopic systems can be used to understand physical processes in the environment. The course will also consider the use of isotopes for understanding palaeoclimatic conditions and for acquiring surface and groundwater ages. The material delivered here will be supported by detailed case studies. Lectures and seminars will give an up-to-date account of this fast-changing subject, and will conclude with a lecture on the new scientific subject of clumped isotopes. This module will run together with ENV347 but with added 400-level practical work and assessment.

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
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</thead>
<tbody>
<tr>
<td>1-3</td>
<td>Introduction, mass spectrometry techniques, and surface dating</td>
<td>GH</td>
</tr>
<tr>
<td>4-6</td>
<td>Radioactive isotopes: rates and dates in aquatic systems</td>
<td>JP</td>
</tr>
<tr>
<td>7-9</td>
<td>Stable isotopes in the environment and palaeoenvironment</td>
<td>GH</td>
</tr>
<tr>
<td>10-12</td>
<td>Noble gas isotopes in the environment and subsurface</td>
<td>GH</td>
</tr>
<tr>
<td>13-15</td>
<td>Groundwater dating and origins, clumped isotopes, summary</td>
<td>GH</td>
</tr>
</tbody>
</table>

**Practical**

1. Data reduction in excel. What it can and can’t do.  
2. Calculating sediment accumulation rates  
3. Modelling stable isotopes in the environment: fractionation factors  
4. Calculating palaeotemperatures using noble gases  
5.  

**Learning objectives:**

On completion of this module a student will be able to:

**Generic**

At a generic level, the students will be able to critically appraise aspects of the scientific literature, formulating robust scientific arguments, using recent research data from the module convenor and others to design solutions to environmental problems. They will gain an appreciation of how isotope data are acquired. Further the students will gain experience in teamwork as well as planning, researching and implementing a group presentation.

**Subject specific**

On successful completion of this module students will be able to demonstrate subject specific knowledge and:

- perform data analysis specific to isotopes
- construct simple models to describe natural systems
- appreciate the variety of applications of different isotope techniques and use different techniques appropriately
- use isotope decay equations to calculate ages

**Assessment:** Exam 50%  
**CWA 50%**

**Details of CWA:**

Data based project - 25%  
Presentation - 25%

**Recommended texts and other learning resources:**

- Reviews in Mineralogy and Geochemistry 43 Stable Isotope Geochemistry
- Reviews in Mineralogy and Geochemistry 47 Noble Gases in Geochemistry and Cosmochemistry
- Reviews in Mineralogy and Geochemistry 52 Uranium Series Geochemistry
Module Number: LEC.427  
Module Title: Crop Protection

Number of weeks: 5  
Term taught: M2  
Contact hours: 30  
Learning hours: 150

Pre-requisites:  
Co-requisites:  
Credits: 15

Module organiser: Jane E Taylor  
Other lecturers: N.D. Paul, A. Wilby

Aims and scope: The aim of this module is to introduce students to key issues surrounding the loss of agricultural & horticultural produce to a range of pests and diseases, and the approaches that can be used to minimise these losses. This understanding will be underpinned by providing detailed knowledge of natural plant defence mechanisms and of the biology and ecology of plant-pathogen and plant-insect interactions, and how these can be exploited to assist in crop protection.

Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>Overview of problems in crop protection. Disease, invertebrate pests, weeds. Chemical control of pests &amp; disease.</td>
<td>NDP</td>
</tr>
<tr>
<td>4</td>
<td>Crop protection through management practices. Agronomic practices, integrated pest management.</td>
<td>JET</td>
</tr>
<tr>
<td>5</td>
<td>Semiochemicals</td>
<td>JET</td>
</tr>
<tr>
<td>6-7</td>
<td>Biological control, Conservation biological control.</td>
<td>AW</td>
</tr>
<tr>
<td>8-9</td>
<td>Plant Defence.</td>
<td>JET</td>
</tr>
<tr>
<td>10</td>
<td>Resistance genes and plant breeding for pest &amp; disease resistance.</td>
<td>JET</td>
</tr>
<tr>
<td>11-12</td>
<td>Genetic modification.</td>
<td>JET</td>
</tr>
<tr>
<td>13-14</td>
<td>Alternative crop protection strategies. Plant activators, elicitors, activation of plant resistance by rhizobacteria.</td>
<td>JET</td>
</tr>
</tbody>
</table>

Practical/workshop

<table>
<thead>
<tr>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Biological control</td>
</tr>
<tr>
<td>4</td>
<td>Plant disease resistance</td>
</tr>
</tbody>
</table>

Learning outcomes:

On completion of this module a student should be able to:
- Appreciate the potential crop losses inflicted by pests and disease.
- Discuss the different strategies used by pests and pathogens to attack plants.
- Explain the genetic basis for plant resistance to pests and disease.
- Explain how co-evolution has resulted in complex interactions between herbivores and pathogens and their hosts.
- Describe a range of approaches to control pests and disease.
- Differentiate between crop protection strategies which directly target the pest and those which enhance natural biological mechanisms for pest control.
- Discuss the pros and cons of conventional pesticide use.
- Describe methods for biological control of invertebrate pests.
- Discuss the potential for GM technology in crop protection.
- Describe alternative crop protection strategies focussed on activation of plant defences.

Assessment:  
CWA: 50%  
Exam: 50%

Details of CWA:
Critical evaluation of scientific literature.

Recommended texts and other learning resources:

- Plants, Genes, and Crop Biotechnology. Chrispeels & Sadava (2003), Jones and Bartlett.
### Module Number: LEC428

**Module Title:** Sustainable Soils Management

<table>
<thead>
<tr>
<th>Number of weeks:</th>
<th>5</th>
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<tbody>
<tr>
<td>Term taught:</td>
<td>M1</td>
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<tr>
<td>Contact hours:</td>
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<tr>
<td>Pre-requisites:</td>
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<td>Credits:</td>
<td>15</td>
</tr>
<tr>
<td>Module organiser:</td>
<td>Ian C Dodd (ICD)</td>
</tr>
</tbody>
</table>

**Other lecturers:**
- Nick Chappell (NC), Phil Haygarth (PH), Nick Ostle (NO), John Quinton (JQ),

**Aims and scope:**
The aim of this module is to introduce students to key issues surrounding the ability of the soil to produce crops, and the agricultural / economic consequences of failing to manage this resource properly. Most agricultural production is dependent on the soil not only to anchor plants, but to supply their hydraulic and nutritional needs. Furthermore, the rhizosphere (soil adjacent to the root surface) is a biological hotspot comprising micro-organisms that can directly or indirectly assist crop nutrient acquisition (rhizobia, mycorrhizae and plant growth promoting rhizobacteria) or cause disease. Increasingly, the soil is being recognised as a global resource to aid carbon sequestration (even in agricultural systems) and/or act as repository for waste derived from other industries.

### Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (10 October)</td>
<td>Soil management through the ages - Sustainability vs Disaster</td>
<td>ICD</td>
</tr>
<tr>
<td>2</td>
<td>Irrigation management: Micrometeorology (FAO) Approach</td>
<td>ICD</td>
</tr>
<tr>
<td>3</td>
<td>Irrigation management: Soil moisture sensors</td>
<td>NC</td>
</tr>
<tr>
<td>4 (17 October)</td>
<td>Irrigation management: Plant Stress Sensing</td>
<td>ICD</td>
</tr>
<tr>
<td>5</td>
<td>Soil salinity (dryland / irrigation / waste water use)</td>
<td>ICD</td>
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<tr>
<td>6</td>
<td>Fertiliser Management: Global issues</td>
<td>ICD</td>
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<tr>
<td>7 (24 October)</td>
<td>Fertiliser Management: Farm-scale</td>
<td>ICD</td>
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<tr>
<td>8</td>
<td>Managing and adding soil organic matter</td>
<td>ICD</td>
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<tr>
<td>9</td>
<td>Soil Biology: Nutrient inputs (rhizobia / mycorrhizae)</td>
<td>ICD</td>
</tr>
<tr>
<td>10 (31 October)</td>
<td>Soil Biology: Managing soilborne disease</td>
<td>ICD</td>
</tr>
<tr>
<td>11</td>
<td>Soil Biology: Stimulating plant growth</td>
<td>ICD</td>
</tr>
<tr>
<td>12</td>
<td>Managing Tillage and Compaction (No till systems)</td>
<td>ICD</td>
</tr>
<tr>
<td>13 (7 November)</td>
<td>Soil Erosion and its prevention</td>
<td>JQ</td>
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<tr>
<td>14</td>
<td>Soils and diffuse pollution</td>
<td>PMH</td>
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<tr>
<td>15</td>
<td>Soil carbon sequestration</td>
<td>NO</td>
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</tbody>
</table>

**Practical/workshop**

<table>
<thead>
<tr>
<th>Title</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>1 How to make an effective scientific presentation</td>
<td>ICD</td>
</tr>
<tr>
<td>2 Visual Soils Assessment</td>
<td>ICD</td>
</tr>
<tr>
<td>3 Student presentations on a range of topics</td>
<td>ICD</td>
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<tr>
<td>4 Irrigation Scheduling using soil moisture sensors</td>
<td>ICD</td>
</tr>
<tr>
<td>5 Visit to Broadbalk long-term experiment at Rothamsted Research</td>
<td>ICD</td>
</tr>
</tbody>
</table>

### Learning outcomes:

On completion of this module a student should be able to:

- Apply soil hydraulic measurements to manage irrigation
- Understand the links between irrigation management and rootzone salinity
- Understand soil and plant-based crop nutrient management
- Evaluate the impacts of plant-microbe interactions on crop disease and nutrient status
- Appraise the impact of soil erosion on water body pollution
- Compare and contrast soil carbon stocks in agricultural / non-agricultural land and evaluate methods to raise soil carbon status

**Assessment:**

- **CWA:** 50 %
- **Exam:** 50 %

**Details of CWA:**

- Practical Report based on irrigation scheduling practical (20%)
- Essay on Sustainability of Management Practices (20%)
- Short Oral Presentation from a choice of topics (10%)

**Recommended texts and other learning resources:**

- Mostly primary literature available online - Also see following texts:
  - Horn (2006) Soil management for sustainability

2013-14
## Aims and Scope
This module will focus on the fate and behaviour of contaminants in the environment, considering fundamental principles and processes which control their fate in environment systems. The material delivered in this module will be supported by detailed case studies, taken from the peer-reviewed sources. This module aims to provide understanding of the fundamental principles relating to the fate and behaviour of contaminants in environmental media for scientists with relevant degrees.

### Syllabus

<table>
<thead>
<tr>
<th>Lecture/workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>General concepts and behaviour of contaminants in the environment</td>
<td>KTS</td>
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<tr>
<td></td>
<td>Atmospheric-organic contaminant interactions</td>
<td>TBA</td>
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<tr>
<td></td>
<td>Behaviour of inorganic contaminants in the environment</td>
<td>TBA</td>
</tr>
<tr>
<td></td>
<td>Pollutant interactions in terrestrial and aqueous environments</td>
<td>KTS</td>
</tr>
<tr>
<td></td>
<td>Modelling of organic contaminant behaviour in the environment</td>
<td>TBA</td>
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<tr>
<td>Workshop/seminars</td>
<td>Workshop 1</td>
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<td></td>
<td>Workshop 2</td>
<td></td>
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<tr>
<td></td>
<td>Student presentation</td>
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<td></td>
<td>Workshop 4</td>
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</tbody>
</table>

### Learning Outcomes
On successful completion of the module the students will be able to demonstrate subject specific knowledge and understanding of fundamental concepts and behaviour of contaminants in the environment, specifically relating to the movement of between and within environmental media, specific biological, chemical and physical fate processes in soil and water and how these processed may be modelled allowing the spatial and temporal to predict environmental behaviour and impact.

At a generic level, the students will be able to critically appraise aspects of the scientific literature, formulating robust scientific arguments, using a range of standard information resources to research a problem. Further the students will gain experience in teamwork as well as planning, researching and implementing a group presentation.

### Assessment:
- CWA: 50%
- Exam: 50%

### Details of CWA:
- Group presentation
- Modelling report

### Recommended texts and other learning resources:
**Main Text:**
**Module Number:** LEC 431  
**Module Title:** Sustainable Systems

- **Number of weeks:** 10  
- **Term taught:** L  
- **Contact hours:** 25  
- **Learning hours:** 150  
- **Pre-requisites:** None  
- **Co-requisites:** None  
- **Credits:** 15

**Module Organiser:** Ian Marshall  
**Other Lecturers:** None

**Aims and Scope:** The module aims to introduce and illustrate the interdependency between the changes needed in all aspects of human activity, at national, organisational and personal scales, for a more sustainable society. The module will discuss a range of current approaches to communicating and managing how to achieve genuine reductions in resource use, and show how they can be applied in all sectors of the economy. A wide range of topics are considered together including: The transformation of production process, infrastructures and systems; Concepts of resource efficiency, dematerialization, decoupling, clean or sustainable technologies, design for the environment, design for sustainability, industrial ecology, life cycle analysis, the reinforcing feedback links between our infrastructures and our materialist values, the need to address both resource efficiency and values.

The core objective is to prepare students for employment as sustainability advisors as this is a current critical skills shortage for UK business and a major growth area in employment opportunities.

### Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>National planning - ZCB (UK) Factor 5 (developed countries) and computer based DECC planning tool, avoiding rebound effects</td>
<td>Ian Marshall</td>
</tr>
<tr>
<td>2</td>
<td>Systems thinking - an introduction to interdependency and its management</td>
<td></td>
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<tr>
<td>3</td>
<td>Finance and Economics - low growth, zero growth or degrowth, are any of these possible</td>
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<tr>
<td>4</td>
<td>Infrastructure design and management (water, telecom, grid, govt, schools, police, military, etc) - and how can individual/social choices influence efficiency of provision.</td>
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<tr>
<td>5</td>
<td>Industry and commerce - Cradle to Cradle processing - recycling should be upcycling not downcycling, reduce waste rather than burning it etc</td>
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<tr>
<td>6</td>
<td>Architecture, efficient building and heating options, social barriers, etc. Agriculture - Food system changes, sustainable diets and motivating food choices</td>
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<tr>
<td>7</td>
<td>Transport - electrification opportunities and barriers</td>
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<td>8</td>
<td>Behavioural change - Objective measures and social and psychological drivers of consumption</td>
<td></td>
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<tr>
<td>9</td>
<td>Bottom up alternatives - an introduction to transition/permaculture, and other alternative visions of future society</td>
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<tr>
<td>10</td>
<td>Practical/workshop</td>
<td></td>
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<tr>
<td></td>
<td>2 field trips are planned. One to a range of local sites, including Halton co-housing, Dewlay, Middlewood, Salt Ayre leisure centre, Growing with nature, and one to Shotton Paper mill</td>
<td>Ian Marshall</td>
</tr>
</tbody>
</table>

**Learning Outcomes:**  
Students will be aware of mainstream and alternative approaches to a more sustainable future in all sectors of the economy including energy, transport, buildings, finance, agriculture manufacturing and retail. They will understand and be able to use system thinking, be able to develop practical sustainability action plans, and communicate their plans in the form of sustainability proposals.

**Assessment:**  
CWA: 100%

**Details of CWA:**  
a) National sustainability plan (current footprint and future action - proposal) (600 words - 20%)  
b) sustainable business plan. Optional focus on water, heat, food, transport or any other relevant area where demand needs to be more sustainable (2000 words - 60%)  
c) spreading the message - propose a campaign AND discuss the likely impacts of the campaign. (600 words - 20%)

**Recommended Texts and other learning resources:**  
Core - Factor five (Weizsacker et al, Earthscan 2009))
**Module Number:** LEC432  
**Module Title:** Low Carbon Energy Use  

<table>
<thead>
<tr>
<th>Number of weeks: 5</th>
<th>Term taught: M</th>
<th>Contact hours: 30</th>
<th>Learning hours: 150</th>
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</table>

**Pre-requisites:**  
**Co-requisites:**  
**Credits:** 15

**Module organiser:** Ian Marshall  
**Other lecturers:** Roger Kemp

### Aims and scope:

The energy crisis will only be solved by the exploitation of low-carbon energy supplies and a reduction in our use of energy. Energy saving offers more short-term opportunities than the creation of new supplies. This module, designed for students with a limited background in engineering, gives an outline of how energy is used in the UK and what can be done to make savings. The module is suitable for students considering a career in environmental science or energy management.

### Syllabus

Revision of basic concepts - kinetic, potential, electrical and chemical energy; heat transfer: conduction, convection and radiation, principles of dc and ac electric circuits.  
First and Second Law of Thermodynamics, Carnot cycle efficiency, practical systems for energy conversion.  
Introduction to electrical technology: generation, transmission, renewable generation, management of intermittency.  
UK energy statistics; where energy comes from and how it is used.  
Domestic energy use, calculation of heat loss from buildings, introduction to low energy housing; heat pumps, solar energy and other relevant technologies.  
Transport energy, including electric vehicles, hydrogen, biofuels and other novel systems.  
Managing industrial and commercial energy use.

### Learning outcomes:

On successful completion of this module students will be able to analyse the energy use in a domestic building, industrial, commercial or third sector concern and make relevant proposals for its reduction. They will be able to use “carbon footprint” software to compare alternative scenarios.

Students will be able to take an overview of energy use in business. They will be able to understand the language and jargon of specialist consultants who might be brought in to advise of specific issue and they will be able to act as an “an informed customer” for such advice.

### Assessment:

CWA: 100%

**Details of CWA:** Individual essay (100%)

### Recommended texts and other learning resources:

- MacKay J.C., Sustainable energy without the hot air, UIT Cambridge ISBN 978-09544529-3-3
- International Panel on Climate Change (IPCC) 4th Assessment Report (May 2007)
- UK Energy Research Centre. An Assessment of the Evidence on the costs and impacts of intermittent generation on the British electricity network. (available online or hard copy).

Other resources will be made available on VLE
Food security is one of the major global challenges currently facing humankind. In 1995 when Lester Brown asked this provocative question, ‘who will feed China?’ the whole world was listening and China was shocked! The question is pertinent because although China’s land size is the third largest on the planet, total land available for agriculture is only about 120 million hectares, less than 0.1 hectare per head of population and far below the world’s average. In addition, China's agricultural resources are limited (Fan et al 2011). If the best use cannot be made of limited arable land and water resources, or appropriate food cannot be imported, food security in China is threatened. China has to feed 20% of the global population with only about 5% of the planet's water resources and 7% of its arable land. Statistics of this kind highlight the importance of studying the issues contributing to food insecurity in this politically important country. In this course we will look at China's history of food production and its recent successes. But of course, food security is about much more than food production. We will also examine changes in society that influence how much people have to eat and what they eat.

Aims and scope: Food security is one of the major global challenges currently facing humankind. In 1995 when Lester Brown asked this provocative question, ‘who will feed China?’ the whole world was listening and China was shocked! The question is pertinent because although China’s land size is the third largest on the planet, total land available for agriculture is only about 120 million hectares, less than 0.1 hectare per head of population and far below the world’s average. In addition, China's agricultural resources are limited (Fan et al 2011). If the best use cannot be made of limited arable land and water resources, or appropriate food cannot be imported, food security in China is threatened. China has to feed 20% of the global population with only about 5% of the planet's water resources and 7% of its arable land. Statistics of this kind highlight the importance of studying the issues contributing to food insecurity in this politically important country. In this course we will look at China's history of food production and its recent successes. But of course, food security is about much more than food production. We will also examine changes in society that influence how much people have to eat and what they eat.

Syllabus

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<tr>
<th>Lecture</th>
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<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introductory material for the course delivered before we depart for China</td>
<td>WJD</td>
</tr>
<tr>
<td>Practical/workshop</td>
<td>Global Food Security and the History of Food and Farming in China, Recent trends in Food Production in China and the Science Behind these Trends. How Science can be introduced into farming to bring about change in practice. Who eats What and is it safe?. Social and Cultural Changes in Modern Day China and the Political Implications of Food. Urban and Rural Populations Changes and the Implications of this. Environmental issues in China.</td>
<td>WJD</td>
</tr>
</tbody>
</table>

Learning outcomes:

On completion of this module a student will have an understanding of: Issues underpinning Global Food Security. The History of Food and Farming in China, Recent trends in Food Production in China. The Science Behind these Trends. How Science can be introduced into farming to increase the production and the quality of food. Who eats What? The traditional Chinese diet and the aspiration for more Westernised food. The health and environmental implications of these changes. Food Safety. Social and Cultural Changes in Modern Day China, Urban and Rural Populations Changes and the Implications of this. The Political Implications of maintaining food availability. Environmental issues in China relevant to food production and the quality of peoples' lives. On successful completion of this module students, the domestic impact of China's economic success should be readily apparent. The country also provides a good model for studying the effects of climate change on agriculture and the natural environment and for the ways in which science and technology can aid social and economic development.

Assessment:

CWA: % 100
Exam: % 0
Module Test: % 0

Details of CWA:

Students will be asked to address one of a selection of questions designed to reveal understanding of particular aspects of the operation of the ‘food system’ in China. Outline sample answers will be available to allow early selection of topics where students’ prior expertise will be advantageous. Students will have their outline plans approved early in the course. Credit will be given as follows: Comprehensive coverage of the issue - 20%. Precision in the answer, effective presentation of the report - 20%. Evidence of literature research - 30%. Evidence of assimilation and application of knowledge gained during the summer school - 30%. Maximum of 5000 words presented within one week of return to UK

Recommended texts and other learning resources:

Aims and scope:
This module will address the possible positive and negative effects that various forms of renewable energy have on the environment. Students will develop a critical understanding of the key concepts of renewable energy, and the tools and techniques for assessing the environmental impacts of renewable energy schemes. In particular, they will be able to assess the challenges facing the development and deployment of large renewable energy schemes and the uncertainties related to their environmental impact.

Syllabus

The module consists of a series of formal lectures on key concepts and current issues followed by seminars in weeks 11-15 and workshops in weeks 16-20.

Key topics for lectures and seminars weeks 11-15
1. Sources of renewable energy and the scale of the available resources
2. Renewable energy: opportunities, problems and choices
3. The UK regulatory regime relevant to renewable energy
4. Introduction to environmental impact assessment (EIA) for renewable energy schemes
5-9. Assessment of the positive and negative environmental effects of a range of renewable energy schemes: biomass, solar, wind, hydropower, offshore wind, tidal and waves.
10. Environmental impact assessment case study

Workshops weeks 16-20
Students will work in groups on an environmental impact plan for a chosen renewable energy scheme.

Learning outcomes:
On successful completion of this module a student will be able to:

- Demonstrate knowledge of the range of practical renewable energy sources
- Assess the potential capacity of a given renewable energy source in a particular situation
- Assess the potential environmental impact of each renewable energy source
- Demonstrate knowledge of the regulatory restrictions on renewable energy schemes
- Present the outcomes of the assessment to the general public

Assessment: 
CWA: 100%

Details of CWA:

1) An individual environmental impact assessment report (4000 words) (80%)

2) A group presentation outlining key issues, information used to support environmental impact assessment and recommendations (20%)

Recommended texts and other learning resources:

**Module Number:** LEC.435  
**Module Title:** LAKE ECOLOGY

<table>
<thead>
<tr>
<th>Number of weeks:</th>
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<tbody>
<tr>
<td>Term taught:</td>
<td>M1</td>
</tr>
<tr>
<td>Contact hours:</td>
<td>Learning hours: 150</td>
</tr>
<tr>
<td>Pre-requisites:</td>
<td>Basic knowledge of Ecology</td>
</tr>
<tr>
<td>Credits:</td>
<td>15</td>
</tr>
<tr>
<td>Module organiser:</td>
<td>Dr P Barker/Dr S Maberly CEH</td>
</tr>
<tr>
<td>Other lecturers:</td>
<td>Specialists in lake ecology CEH Lancaster</td>
</tr>
</tbody>
</table>

**Aims and scope:** This module aims to introduce the principles of lake ecology, an area with an acknowledged national lack of expertise. The course presents a holistic approach to the drivers and internal interactions that control water quality in lakes. The course will teach basic ecological principles, elucidated using lake ecology, introduce application of state-of-the-art techniques and provide essential background information for anyone dealing with EU Directives such as the Water Framework Directive in the future.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Overview to the structure and rationale of the course</td>
<td>P Barker</td>
</tr>
<tr>
<td></td>
<td>Introduction to lakes and their role in the landscape and global cycling</td>
<td>S Maberly</td>
</tr>
<tr>
<td></td>
<td>Records of long-term change</td>
<td>S Maberly</td>
</tr>
<tr>
<td></td>
<td>Phytoplankton &amp; macrophytes</td>
<td>S Maberly</td>
</tr>
<tr>
<td>Week 2</td>
<td>Zooplankton</td>
<td>S Thackeray</td>
</tr>
<tr>
<td></td>
<td>Lake physics &amp; atmospheric drivers</td>
<td>A Folkard</td>
</tr>
<tr>
<td></td>
<td>Lake Modelling</td>
<td>A Elliott</td>
</tr>
<tr>
<td>Week 3</td>
<td>Fish biology</td>
<td>I Winfield</td>
</tr>
<tr>
<td></td>
<td>Sediments as a record of change</td>
<td>P Barker</td>
</tr>
<tr>
<td></td>
<td>Acidification &amp; recovery</td>
<td>D Monteith</td>
</tr>
<tr>
<td>Week 4</td>
<td>Methods of sampling lakes: field trip on Windermere</td>
<td>I Winfield</td>
</tr>
<tr>
<td></td>
<td>Nutrient sources to lakes</td>
<td>P Haygarth</td>
</tr>
<tr>
<td>Week 5</td>
<td>Trophic interactions &amp; alternative stable states</td>
<td>H Feuchtmayr</td>
</tr>
<tr>
<td></td>
<td>Multiple stressors &amp; the Water Framework Directive</td>
<td>S Thackeray</td>
</tr>
<tr>
<td>Prac/wsp</td>
<td>Title</td>
<td>Lecturer</td>
</tr>
<tr>
<td>Week 1</td>
<td>Phytoplankton and zooplankton observation and ecology</td>
<td>Maberly, Thackeray &amp; Barker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elliott</td>
</tr>
<tr>
<td>Week 2</td>
<td>Modelling lake responses to external forcing</td>
<td>Elliott</td>
</tr>
<tr>
<td>Week 3</td>
<td>Use of high-frequency lake measurements to estimate physical factors &amp; response to climate forcing</td>
<td>Folkard</td>
</tr>
<tr>
<td>Week 4</td>
<td>Methods of sampling lakes: field trip to Windermere (as above)</td>
<td>Winfield &amp; Thackeray</td>
</tr>
<tr>
<td>Week 5</td>
<td>Methods of sampling lakes: field trip to Windermere (as above)</td>
<td>Winfield &amp; Thackeray</td>
</tr>
</tbody>
</table>

**Prac/wsp**  
**Week 1**  
Phytoplankton and zooplankton observation and ecology  
Lecturer: Maberly, Thackeray & Barker  
Elliott

**Week 2**  
Modelling lake responses to external forcing  
Folkard

**Week 3**  
Use of high-frequency lake measurements to estimate physical factors & response to climate forcing  
Folkard

**Week 4**  
Methods of sampling lakes: field trip to Windermere (as above)  
Winfield & Thackeray

**Week 5**  
Methods of sampling lakes: field trip to Windermere (as above)  
Winfield & Thackeray

**Learning outcomes:**  
On completion of this module a student should be able to:  
- Understand the fundamentals of how lakes function  
- Understand the tools and approaches needed to study and manage lakes  
- Appreciate the complex interplay between external drivers and internal interactions within lakes  
- Understand the science underpinning the Water Framework Directive  
- Identify the processes leading to nutrient inputs to lakes  
- Demonstrate a knowledge of the effects of climate change on lakes  
- Identify the factors controlling fish populations  
- Understand the potential and limits of state-of-the-art techniques in lake ecology  
- Appreciate the principles and uses of lake and catchment modelling

**Assessment:**  
CWA: 100%

**Details of CWA:**  
A 4000 word report accounts for 80% of the coursework element and 20% is from a presentation. These skills are essential in preparing students for future careers.

**Recommended texts and other learning resources:**  

2013-14
### Module Title: Conservation and Sustainable Development in the Brazilian Amazon

**Number of weeks:**
- Term taught: Mich & Lent

**Contact hours:** 70
**Learning hours:** 150

**Pre-requisites:** None
**Co-requisites:** None
**Credits:** 15

**Module organiser:** Luke Parry
**Other lecturers:** Jos Barlow

### Aims and Scope:
The field course will be based in the Jari region of the north-eastern Brazilian Amazon, drawing on a decade of research in the area by LEC faculty (Parry and Barlow). Students’ understanding of key conservation and development issues will be enhanced through first-hand exposure to a uniquely accessible and diverse area of the Amazon in which issues such as sustainable forest management, biodiversity monitoring and rural livelihoods are being addressed and transformed. The institutional host will be the FSC-certified forest management company, Grupo Orsa, who have a long-term research agreement with LEC. This field course offers the potential for joint teaching with colleagues from Lavras University, whom have expressed interesting in participating.

### Syllabus

**Seminar * 6 hours**
- Preparatory seminar discussion in Lancaster
- Luke Parry

**Field Trip**
- Students will rotate between ecological and development-oriented activities, covering the following topics:

**Conservation and ecology**
1. Challenges of managing a strictly protected area in the Amazon. 2. Sustainable forest management and certification. 3. Biodiversity monitoring in primary forest and plantation landscapes (insects, vertebrates). 4. Measuring above-ground carbon stocks and forest condition

**Development**
1. Family agriculture and rural development: the role of migration and emerging land-uses. 2. Forest livelihoods and the collection of non-timber forest products. 3. Urban development in shantytown of Laranjal do Jari versus “westernized” Monte Dourado

### Learning outcomes:
On completion of this module a student should be able to:

* Develop critical arguments based on evidence from natural and social sciences.
* Write effectively using a diverse evidence base.
* Critically evaluate international and national policies.
* Implement field research techniques for tropical research.
* Demonstrate original thinking.
* Contribute to spoken debates with confident and thoughtful speech

### Assessment:
- **CWA:** 100%
- **Exam:** 0%
- **Module Test:** 0%

**Details of CWA:** The module will be 100% coursework, with 25% from a 1000 word pre-trip preparatory assignment, and 75% from a post-field course 3500 word assignment building on their experiences and learning gained during the field course. This assignment will need to compare and contrast the Amazonian conservation and development context with the environmental, economic and social realities of other regions of the forested tropics.

### Recommended texts and other learning resources:


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2013-14
**Please note: This is an unassessed module to be taken as required**

<table>
<thead>
<tr>
<th>MODULE NUMBER: LEC 440</th>
<th>MODULE TITLE: NUMERICAL SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of weeks</strong>: 20</td>
<td><strong>Term taught</strong>: L &amp; M</td>
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<tr>
<td><strong>Contact hours</strong>: 9</td>
<td><strong>Credits</strong>: None - Masters support course</td>
</tr>
<tr>
<td><strong>Pre-requisites</strong>: None</td>
<td><strong>Co-requisites</strong>: None</td>
</tr>
<tr>
<td><strong>Module organiser</strong>: Dr. Steve Lane</td>
<td><strong>Other lecturers</strong>:</td>
</tr>
</tbody>
</table>

**Aims and scope**: This module provides numerical skills resources and support for students who find the subject difficult or need revision of long-forgotten courses. This module is for you if:
1. you do not have a 16+ maths qualification, e.g., A-level or Scottish Higher in the UK,
2. your undergraduate degree did not provide significant numerical skills support,
3. your undergraduate degree did not include significant numerical content, or
4. you need revision of any of the topics listed below.

If you fall into any of the above categories, then this module will improve your prospects by providing:
1. resource and support for any modules you take that include numerical content, and
2. improved numerical skills greatly valued by employers and the research community.

LEC 440 is delivered through:
1. a module schedule available on Moodle,
2. applied examples of numerical skills available through Moodle,
3. online lessons and exercises through MyMaths (www.mymaths.co.uk) with login lancuni and password albite,
4. MyMaths set homework, and
5. drop-in help sessions (three per term).

**Syllabus**

**Units and Dimensions**: SI unit system; unit conversion; dimensional analysis; exercises based on environmental examples.

**Algebra**: This most essential of numerical skills often causes great difficulty and impedes progress in other areas of numerical work. Here we concentrate on the components of equations (constants, variables, operators) and how to manipulate them into more useful forms.

**Graphs, Linear Functions and Quadratic equations**: axes; plotting points; clear presentation; plotting equation of a straight line y=mx+c; slope and gradient. Exercises based on environmental examples, e.g. field data from a variety of sources.

**Exponential and logarithmic functions**: integer and fractional (surds) powers; negative powers; e; log₁₀; ln; relationship between logs and exponents; plotting logarithmic and exponential functions; Exercises based on environmental examples

**Power law and Exponential Law**: Transformation to linear form.

**Basic Trigonometry**: Sine, Cosine, Tangent. Degrees and radians; Oscillatory behaviour and Periodicity; Seasonal variation; Exercises based on environmental examples,

**Differentiation** : Notation; Basic definition; Rates of change; gradient;

**Area under a curve**: trapezium rule; Simpson's Rule

**Integration**: Notation; Basic definition; Inverse of differentiation.

**Environmental Statistics, uncertainty and data analysis**: Understanding of statistical parameters including mean and standard deviation, errors and estimates of uncertainty, propagation of uncertainties through equations.

**Recommended texts and other learning resources**:
Online lessons and tasks from MyMaths (http://www.mymaths.co.uk/)
Material from Moodle pages.

2013-14
**Module Number:** LEC. 500  
**Module Title:** Dissertation Project (30 Credit)

<table>
<thead>
<tr>
<th>Number of weeks:</th>
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<th>Contact hours:</th>
<th>Learning hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All year</td>
<td>40</td>
<td>300</td>
</tr>
</tbody>
</table>

**Pre-requisites:** None  
**Co-requisites:** Credits: 30

**Module organiser:** Dr Ian Hartley  
**Other lecturers:** Dr Mike Roberts, Dr Robert Blake, Dr Andrew Jarvis, Dr Chris Sherlock  
Prof. Barbara Maher

**Aims and scope:**
This module, leading to the award of a PG Diploma, is an option for students who due to unforeseen circumstances, may need to curtail their course or for some reason are unable to complete a full-length Masters dissertation project. This module covers the full development, execution and delivery of the dissertation. In addition to the project, a series of 1 hour dissertation support seminars will be given on specific research skills, as detailed below, and assessment will be made at several stages, as outlined below.

**Syllabus**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Convener</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-20</td>
<td></td>
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<tr>
<td>Introductory seminar</td>
<td>IH</td>
</tr>
<tr>
<td>Scientific communication</td>
<td>RB</td>
</tr>
<tr>
<td>Data presentation</td>
<td>AJ</td>
</tr>
<tr>
<td>Writing scientific papers</td>
<td>MRR</td>
</tr>
<tr>
<td>Use of statistics</td>
<td>CS</td>
</tr>
<tr>
<td>Writing funding applications</td>
<td>BAM</td>
</tr>
<tr>
<td>Endnote for bibliographic referencing</td>
<td>ISS</td>
</tr>
<tr>
<td>Preparing Posters using Powerpoint</td>
<td>ISS</td>
</tr>
<tr>
<td>W17</td>
<td></td>
</tr>
<tr>
<td>Interim reporting</td>
<td>Supervisor</td>
</tr>
<tr>
<td>W28</td>
<td></td>
</tr>
<tr>
<td>LEC Masters poster day</td>
<td>Supervisor</td>
</tr>
<tr>
<td>W40</td>
<td></td>
</tr>
<tr>
<td>Dissertation submission</td>
<td>Supervisor</td>
</tr>
</tbody>
</table>

**Learning outcomes:**
On completion of this module students will be able to:

- Plan, execute and present the findings of a masters level research project
- Write concisely and effectively in order to communicate concepts and ideas in a logical and coherent manner
- Produce effective data presentations and use them to enhance the communication of quantitative information
- Understand the requirements of funding applications and how to go about preparing one
- Use standard project management tools in order to deliver to predetermined goals effectively
- Creating, presenting and defending a poster at a scientific meeting

**Assessment**

**Part 1 (formative)**
- Interim Report. This four page document will provide an outline of the project and will include its aims and objectives, proposed methods to be used and a detailed project management specification
- Poster Presentation.

**Part 2 (summative)**
A 5,000 word dissertation

2013-14
**Module Number:** LEC.501  
**Module Title:** Dissertation Project

<table>
<thead>
<tr>
<th>Number of weeks:</th>
<th>Term taught: All year</th>
<th>Contact hours: 40</th>
<th>Learning hours: 900</th>
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<tr>
<td>Pre-requisites:</td>
<td>None</td>
<td>Co-requisites:</td>
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</tbody>
</table>

**Module Organiser:** Dr Ian Hartley  
**Other Lecturers:** Dr Mike Roberts, Dr Robert Blake, Dr Andrew Jarvis, Dr Chris Sherlock, Prof. Barbara Maher

**Aims and Scope:**
This module covers the full development, execution and delivery of the Masters dissertation. In addition to the project, a series of 1 hour dissertation support seminars will be given on specific research skills, as detailed below, and assessment will be made at several stages, as outlined below.

**Syllabus**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Convenor</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-20</td>
<td></td>
</tr>
<tr>
<td>Introductory seminar</td>
<td></td>
</tr>
<tr>
<td>Scientific communication</td>
<td>IH</td>
</tr>
<tr>
<td>Data presentation</td>
<td>RB</td>
</tr>
<tr>
<td>Writing scientific papers</td>
<td>AJ</td>
</tr>
<tr>
<td>Use of statistics</td>
<td>MRR</td>
</tr>
<tr>
<td>Writing funding applications</td>
<td>CS</td>
</tr>
<tr>
<td>Endnote for bibliographic referencing</td>
<td>BAM</td>
</tr>
<tr>
<td>Preparing Posters using Powerpoint</td>
<td>ISS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Convenor</th>
</tr>
</thead>
<tbody>
<tr>
<td>W17</td>
<td></td>
</tr>
<tr>
<td>Interim report</td>
<td>Supervisor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Convenor</th>
</tr>
</thead>
<tbody>
<tr>
<td>W28</td>
<td></td>
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<tr>
<td>LEC Masters poster day</td>
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</tr>
</tbody>
</table>

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>W40</td>
<td></td>
</tr>
<tr>
<td>Dissertation submission</td>
<td>Supervisor</td>
</tr>
</tbody>
</table>

**Learning Outcomes:**
On completion of this module students will be able to:

- Plan, execute and present the findings of a masters level research project
- Write concisely and effectively in order to communicate concepts and ideas in a logical and coherent manner
- Produce effective data presentations and use them to enhance the communication of quantitative information
- Understand the requirements of funding applications and how to go about preparing one
- Use standard project management tools in order to deliver to predetermined goals effectively
- Creating, presenting and defending a poster at a scientific meeting

**Assessment**

**Part 1 (formative)**
- Interim Report. This four page document will provide an outline of the project and will include its aims and objectives, proposed methods to be used and a detailed project management specification
- Poster Presentation.

**Part 2 (summative)**
A 10,000 word dissertation
**Module Number:** LEC.502  
**Module Title:** Dissertation Project

<table>
<thead>
<tr>
<th>Number of weeks:</th>
<th>Term taught:</th>
<th>Contact hours:</th>
<th>Learning hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All year</td>
<td>40</td>
<td>1200</td>
</tr>
</tbody>
</table>

Pre-requisites: None  
Co-requisites: Credits: 120

**Module Organiser:** Dr Ian Hartley  
**Other lecturers:** Dr Mike Roberts, Dr Robert Blake, Dr Andrew Jarvis, Dr Chris Sherlock, Prof. Barbara Maher

**Aims and Scope:**
This module covers the full development, execution and delivery of the masters dissertation. In addition to the project, a series of 1 hour dissertation support seminars will be given on specific research skills, as detailed below, and assessment will be made at several stages, as outlined below.

**Syllabus**

<table>
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<tr>
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<tbody>
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<td>Writing funding applications</td>
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<td>Supervisor</td>
</tr>
<tr>
<td>Dissertation submission</td>
<td>Supervisor</td>
</tr>
</tbody>
</table>

**Learning Outcomes:**
On completion of this module students will be able to:

- Plan, execute and present the findings of a masters level research project
- Write concisely and effectively in order to communicate concepts and ideas in a logical and coherent manner
- Produce effective data presentations and use them to enhance the communication of quantitative information
- Understand the requirements of funding applications and how to go about preparing one
- Use standard project management tools in order to deliver to predetermined goals effectively
- Creating, presenting and defending a poster at a scientific meeting

**Assessment**

**Part 1 (formative)**
- Interim Report. This four page document will provide an outline of the project and will include its aims and objectives, proposed methods to be used and a detailed project management specification
- Poster Presentation.

**Part 2 (summative)**
A 15,000 word dissertation

2013-14
Module Outlines from other Departments
**MODULE NUMBER: BIOL 434**  
**MODULE TITLE: EMERGING THERAPEUTICS IN IMMUNOLOGY**

<table>
<thead>
<tr>
<th>Number of weeks: 5</th>
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<th>Contact hours: 25</th>
<th>Learning hours: 150</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-requisites:</strong> Suitable BSc or equivalent</td>
<td><strong>Co-requisites:</strong> None</td>
<td><strong>Credits:</strong> 15</td>
<td></td>
</tr>
<tr>
<td><strong>Module organiser:</strong> Dr Jane Owen-Lynch</td>
<td><strong>Other lecturers:</strong> Dr Gill Vince (Medicine)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Aims and scope:**
The aim of this module is to provide the students with a broad understanding of the human immune system, a more detailed knowledge of human immunological disorders, and the application of immunological reagents, particularly antibodies, to biomedical science and clinical practice. On the skills side the students will experience the varied ways in which antibodies can be engineered for, and used in, biomedical research and clinical practice.

**Syllabus**

<table>
<thead>
<tr>
<th>Day</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Overview of the Human Immune System</td>
<td>PJOL</td>
</tr>
<tr>
<td>3</td>
<td>Humoral Mediated Immunity</td>
<td>PJOL</td>
</tr>
<tr>
<td>4</td>
<td>Cell-mediated Immunity</td>
<td>PJOL</td>
</tr>
<tr>
<td>5</td>
<td>Allergies and Asthma</td>
<td>PJOL</td>
</tr>
<tr>
<td>6</td>
<td>Transplantation Immunology</td>
<td>PJOL</td>
</tr>
<tr>
<td>7</td>
<td>Reproductive Immunology I</td>
<td>GV</td>
</tr>
<tr>
<td>8</td>
<td>Reproductive Immunology II</td>
<td>GV</td>
</tr>
<tr>
<td>9</td>
<td>Immunodeficiencies (including AIDS)</td>
<td>PJOL</td>
</tr>
<tr>
<td>10</td>
<td>Autoimmune diseases</td>
<td>PJOL</td>
</tr>
</tbody>
</table>

**Workshops and Practicals**

Theme: Diagnostic and Therapeutic Use of Antibodies.
3. Workshop: ELISA data analysis and Immunodeficiencies (case studies)  
4. Workshop: A vaccine for HIV?  
5. Practical Session: Diagnostic ELISA

**Learning Outcomes:**

**Generic Outcomes**

On successful completion of the module students should be able to:
- Apply biochemical and cell biological research methods to biomedical problems.
- Appreciate the commercial potential of biomedical reagents.
- Interpret data and observations in a biomedical context.
- Source, analyse and précis scientific literature.
- Prepare and delivery scientific summaries under time limited conditions.

**Subject Specific**

On successful completion of the module students should be able to:
- Understand the components of the immune system and their role in host defence.
- Explain how B-cells responses and antibody production are critical in the host defence against pathogens.
- Explain the role of T-cells in the immune response and describe how these cells induce death in compromised cells.
- Appreciate the importance of antibodies in biomedical research and have basic understanding of technologies involved in antibody engineering.
- Understand the causes and consequences of failure of the whole or part of the immune system.
- Understand the consequences of loss of selectivity in the immune response.
- Have knowledge of how immunological techniques can be applied in a clinical setting.

**Assessment:**

<table>
<thead>
<tr>
<th>CWA: 50%</th>
<th>Exam: 50%</th>
</tr>
</thead>
</table>

**Details of CWA:**

a) Practical report from ELISA practical (25%).  
b) Course essay (25%). Title to be announced at the start of the course but based around the potential of engineered antibodies as clinical tools in diagnostics and treatments.

**Recommended texts and other learning resources:**

As a starting point the required reading for this course is ‘Kuby Immunology’ (5th or 6th edition) written by Kindt, Goldsby and Osborne. Numerous copies are available in the library. Other reviews and primary paper material will be listed in each lecture and workshop session.

2013-2014
**PLEASE NOTE: MODULE SUBJECT TO POSSIBLE CHANGES**

**MODULE NUMBER: BIOL435 | MODULE TITLE: MICROBES AND DISEASE**

<table>
<thead>
<tr>
<th>Number of weeks: 5</th>
<th>Term taught: L1</th>
<th>Contact hours: 25</th>
<th>Learning hours: 150</th>
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</table>

<table>
<thead>
<tr>
<th>Pre-requisites:</th>
<th>Co-requisites:</th>
<th>Credits: 15</th>
<th>Other lecturers:</th>
</tr>
</thead>
</table>

**Module organiser:** TBC

**Aims and scope:** This module aims to provide an insight into the huge impact pathogenic microorganisms can have upon human health and develop an awareness of the challenges and realities of controlling infectious diseases.

**Syllabus**

<table>
<thead>
<tr>
<th>Day</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. Introduction - global impact of infectious diseases on human health. 2. Emerging/re-emerging infectious diseases - HIV, influenza, opportunistic infections, Tuberculosis</td>
<td>TBC</td>
</tr>
<tr>
<td>2</td>
<td>3. The host-pathogen relationship - gut pathogens &amp; the hygiene hypothesis 4. The host-pathogen relationship - gut pathogens &amp; the hygiene hypothesis</td>
<td>TBC</td>
</tr>
<tr>
<td>3</td>
<td>5. Epidemiology and Public Health 6. Mathematical modelling of infectious human diseases</td>
<td>TBC</td>
</tr>
<tr>
<td>4</td>
<td>7. New challenges for healthcare systems - antibiotic resistance (e.g. MRSA), hospital acquired infections, bioterrorism (e.g. anthrax). 8. Environment and Health - Non-tuberculous mycobacterial infections and Crohn’s Disease</td>
<td>TBC</td>
</tr>
<tr>
<td>5</td>
<td>9. Tropical disease microbiology 10. Tropical disease microbiology</td>
<td>TBC</td>
</tr>
</tbody>
</table>

**Practicals/Workshops**

| 1   | Analysis of primary paper - News and Views article | TBC |
| 2   | Problem Based Learning (I) brainstorming session identifying learning issues | TBC |
| 3   | Computer modelling of infectious disease | TBC |
| 4   | PBL (II) discussion, critical thinking and constructive evaluation | TBC |
| 5   | Powerpoint presentations of PBL reports | TBC |

**Learning Outcomes:**

**Generic Outcomes**

- Critically analyse scientific data.
- Work effectively within teams to produce scientific reports.
- Present scientific findings in both a written and oral format.

**Subject Specific**

- Develop a broad understanding of the range of pathogens and their impact on human health.
- Understand how the human body responds to these pathogens.
- Be aware of the new challenges faced by healthcare systems - emerging infections, antibiotic resistance and bioterrorism.
- Appreciate the role of epidemiology and mathematical modelling in predicting and controlling infectious diseases.
- Understand the importance chemotherapeutic approaches to control pathogenic organisms.
- Be aware of the challenges and realities of delivering disease control strategies.

**Assessment:**

<table>
<thead>
<tr>
<th>CWA: 50%</th>
<th>Exam: 50%</th>
</tr>
</thead>
</table>

**Details of CWA:**

- Preparation of a News and Views article: 15% Hand-in Deadline Monday week 13
- Preparation of Group Powerpoint Presentation: 25% Assessed presentation Friday week 15
- Computer based assessment: 10% Completed within workshop week 13

**Recommended texts and other learning resources:**

Reading lists of relevant reviews and primary literature will be provided during the module.

For a good general microbiology textbooks see:

- Microbiology (with diseases by taxonomy) - Robert Bauman 2nd Edition (Publisher - Pearson)
- Brock Biology of Microorganisms - Michael Madigan and John Martinko 11th Edition (Publisher - Pearson)

2013-14
**Aims and scope:** Prof. Allsop will initially introduce students to the concept of protein misfolding disorders and then expand on this through consideration of two of the major neurodegenerative diseases, Alzheimer’s disease and Parkinson’s disease. He will also talk about the role of oxidative stress in neurodegenerative disease. Prof. Hölscher will then consider the important role played by proteases in Alzheimer’s disease, and consider how some key proteolytic enzymes are being targeted in an attempt to treat this condition. He will also teach about growth factors and neurodegenerative diseases, and how some drugs initially developed for diabetes are being repurposed for possible treatment of various neurodegenerative conditions. Finally, Dr. Broughton will explain how animal models can be used in the laboratory to study both normal brain aging and neurodegenerative diseases.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Disorders of Protein Folding</td>
<td>DA</td>
</tr>
<tr>
<td>2-4</td>
<td>Neurodegenerative Disorders - Alzheimer’s Disease and Parkinson’s Disease</td>
<td>DA</td>
</tr>
<tr>
<td>5,6</td>
<td>Proteolysis in brain disorders</td>
<td>CH</td>
</tr>
<tr>
<td>7,8</td>
<td>Cross-links with diabetes and repositioning of diabetes drugs</td>
<td>CH</td>
</tr>
<tr>
<td>9,10</td>
<td>Animal models to study neurodegeneration and brain aging</td>
<td>SJB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workshops</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2</td>
<td>Practical class on hydrogen peroxide, free radicals and Alzheimer’s disease, including use of electron spin resonance spectroscopy (<em>lab practical</em>).</td>
<td>DA/BT</td>
</tr>
<tr>
<td>3,4</td>
<td>Student talks on scientific papers from the literature.</td>
<td>CH</td>
</tr>
<tr>
<td>5</td>
<td>Workshop on measuring ageing in the fruit fly <em>Drosophila melanogaster</em>, a principal model organism of ageing and neurodegenerative disease.</td>
<td>SJB</td>
</tr>
</tbody>
</table>

**Learning outcomes:**

On successful completion of the module students should:

- Realize that protein misfolding plays an important role in a wide range of human diseases, including those of the brain.
- Understand the molecular, biochemical and genetic factors implicated in Alzheimer’s disease and Parkinson’s disease.
- Know how these diseases are currently diagnosed, treated and managed and how this might be improved in the future.
- Understand how the proteolysis of key proteins is central to the pathogenesis of some neurodegenerative conditions, particularly Alzheimer’s disease, and how targeting of some key proteases is being used in an attempt to treat Alzheimer’s disease.
- Appreciate the role of growth factors in neurodegenerative conditions, and how certain drugs originally developed for diabetes are being repurposed for certain brain diseases.
- Learn how animal models can be used to expand our knowledge of ageing and neurodegeneration.

**General knowledge and skills:**

- Analyse and précis both oral and written scientific presentations.
- Carry out and interpret results from laboratory experiments.
- Write up these results in the format of a brief scientific paper.
- Make a brief oral presentation to other students.

**Assessment:**

CWA: 50% 
Exam: 50%

**Details of cwa:**

1. Write-up of the laboratory practicals in the correct format for a brief scientific communication.
2. Assessment of student talks workshop based on review of a recently published research paper.

**Recommended texts and other learning resources:**

Students will be referred to primary papers and reviews on the topics listed.
# Molecular Basis of Cancer

**Number of weeks:** 5  
**Term taught:** M2  
**Contact hours:** 25  
**Learning hours:** 150

**Pre-requisites:** None  
**Co-requisites:** None  
**Credits:** 15

**Module organiser:** Dr S. Allinson  
**Other lecturers:** Dr G. Brown

## Aims and scope
The aim of this module is to provide an insight into the underlying molecular events in the development of cancer. The workshops and the practical will allow students to study the aetiology and progression of one particular type of cancer in depth and to understand how cancer is studied in practice.

## Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to cancer</td>
<td>SLA</td>
</tr>
<tr>
<td>2.</td>
<td>DNA repair: modulation of BER in cancer aetiology and treatment</td>
<td>SLA</td>
</tr>
<tr>
<td>3.</td>
<td>Synthetic lethality and the treatment of hereditary breast cancer</td>
<td>SLA</td>
</tr>
<tr>
<td>4.</td>
<td>Evasion of checkpoint control</td>
<td>SLA</td>
</tr>
<tr>
<td>5.</td>
<td>Apoptosis and p53</td>
<td>SLA</td>
</tr>
<tr>
<td>6.</td>
<td>Oncogenes: spotlight on Bcr-Abl</td>
<td>SLA</td>
</tr>
<tr>
<td>7.</td>
<td>Telomeres and cellular immortalisation</td>
<td>SLA</td>
</tr>
<tr>
<td>8.</td>
<td>Vascularisation and Metastasis I</td>
<td>GMB</td>
</tr>
<tr>
<td>9.</td>
<td>Vascularisation and Metastasis II</td>
<td>GMB</td>
</tr>
<tr>
<td>10.</td>
<td>Vascularisation and Metastasis III</td>
<td>GMB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practical/ workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Essay-writing workshop and assignment of topics</td>
<td>SLA</td>
</tr>
<tr>
<td>2.</td>
<td>Workshop on experiment design</td>
<td>SLA</td>
</tr>
<tr>
<td>3.</td>
<td>Student presentations</td>
<td>SLA</td>
</tr>
<tr>
<td>4.</td>
<td>Cancer diagnosis and treatment</td>
<td>SLA</td>
</tr>
<tr>
<td>5.</td>
<td>Metastasis (practical)</td>
<td>GMB</td>
</tr>
</tbody>
</table>

## Learning outcomes:
On completion of this module a student will be able to:
- Understand the development of cancer as a multi-step process
- Describe the “six hallmarks of cancer” and give examples of how cells might acquire each of these characteristics
- Explain the role of oncogenes and tumour suppressors in cancer.
- Understand how cancers can access the resources required for their growth and spread throughout the body.
- Explain how an understanding of the molecular basis of cancer has lead to the development of novel cancer treatments

## Assessment:
- **CWA:** 50%  
- **Exam:** 50%

### Details of cwa:
Coursework will be based on each student making an oral presentation on the aetiology and progression of one type of cancer. Students will also prepare an essay on the same. Practical report.

## Recommended texts and other learning resources:
- Reading from primary literature as recommended in lectures

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2013-14
Aims and scope:
The aims of this module are to:
Provide students with an understanding of the tools and methods normally found in a biomedical research lab. Students will be taught skills in experimental planning, equipment operation, data capture and analysis.

Syllabus

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Workshop - Background to lab work</td>
<td>RML</td>
</tr>
<tr>
<td>2</td>
<td>Laboratory - Basic principles of the Biomedical lab</td>
<td>RML</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory - Assays</td>
<td>RML</td>
</tr>
<tr>
<td>4</td>
<td>Laboratory - Molecular separation</td>
<td>RML</td>
</tr>
<tr>
<td>5</td>
<td>Laboratory - Characterising molecules by spectroscopy</td>
<td>RML</td>
</tr>
</tbody>
</table>

Learning Outcomes:

Generic Outcomes

The module will provide students with general knowledge, understanding and skills in:

- Team work,
- Problem solving,
- Prioritising and managing lab resources
- Collection, analysis and interpretation of data,
- Written communication, for example writing a scientific paper and discussion of data in the context of available literature.

Subject Specific

The module will provide students with specific knowledge, understanding and skills in:

- The design of experiments,
- The appropriate use of basic biomedical lab tools,
- Appreciating the limitations of methods and description of alternative approaches which can be used to focus data acquisition,
- Understanding equipment and technical limitations

Assessment:

CWA: 100%  Exam: 0%

Details of CWA:

- Students will be asked to write a short literature review on the structure and function of a molecule of their choice
- Students will be assessed during the lab and workshop session to confirm their competence in the tasks being undertaken.
- Coursework will comprise a report, in the form of a scientific paper, of the work undertaken.
- Students will be required to submit a self-assessment of their own work using the assessment criteria along with the report. This will require them to confirm that they have engaged with the assessment criteria and that they understand how these criteria map onto their work.
- A part of the assessment outcome will be driven by the extent to which this self assessment represents a realistic appraisal of their own work.

Recommended texts and other learning resources:

Bespoke Divisional Practical skills Book


2013-14
### Module Details

**Module Number:** BIOL462  
**Module Title:** MOLECULAR BIOLOGY SKILLS  
**Number of weeks:** 2  
**Term taught:** M  
**Contact hours:** 25  
**Learning hours:** 75  
**Pre-requisites:**  
**Co-requisites:** Biol 461  
**Module organiser:** Dr Christine Shirras  
**Other lecturers:** tbc  
**Credits:** 7.5

### Aims and Scope

This module will revise basic DNA structure and recombinant DNA techniques, emphasising the role that recombinant DNA technology plays in medical research and practice. The second half of the course will focus upon the uses of bioinformatic analysis of sequence data, proteomics and the role of microarray analysis for investigating alterations in gene expression in the disease state.

### Syllabus

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Cloning a gene (III). Strategies for confirmation of recombinant plasmid production (blue/white screening, colony PCR, restriction digest).</td>
<td>CAMS</td>
</tr>
<tr>
<td>4.</td>
<td>Bioinformatic analysis of sequence data.</td>
<td>tbc/CAMS</td>
</tr>
<tr>
<td>5.</td>
<td>Proteomics. Microarray analysis to determine alterations in gene expression in the disease state.</td>
<td>tbc/CAMS</td>
</tr>
</tbody>
</table>

### Learning Outcomes

**Generic Outcomes**  
The module will provide students with general knowledge, understanding and skills in:
- Team work  
- Problem solving  
- Prioritise and manage lab resources.  
- Collection, analysis and interpretation of data  
- Written communication and discussion of data in the context of available literature.

**Subject Specific**  
The module will provide students with specific knowledge, understanding and skills in:
- Fundamental molecular biology techniques for preparation of recombinant plasmids, blue/white screening, PCR and agarose gel electrophoresis.  
- Bioinformatic analysis of sequence data  
- Proteomics  
- Microarray analysis to determine gene expression alteration in a disease state.

### Assessment

**CWA:** 100%  
**Exam:** 0%

**Details of CWA:**
- A report describing how recombinant DNA technology could be used in the treatment of a given disease.  
- Practical skills will be assessed during practicals 1-3.  
- A report describing the bioinformatic and microarray analyses carried out in practicals 4-5. This must also refer to the scientific literature on the given topic.

### Recommended Texts and Other Learning Resources:

- iGenetics. Peter J Russell  
- Bespoke Divisional Practical skills Book  

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2013-14
The module will provide students with subject specific knowledge, understanding and skills in the theory and practice of cell biology. In addition, the module will expose learners to techniques for the examination of the level of expression and activity of a target protein in response to molecular signals.

**Syllabus**

<table>
<thead>
<tr>
<th>Day</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction - cell counting and viability</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Flow cytometry</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cell stimulations and protein separation</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Immunoblotting and proliferation assays</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Confocal microscopy. Final analysis of results.</td>
<td></td>
</tr>
</tbody>
</table>

**Learning Outcomes:**

**Generic Outcomes**
The module will provide students with general knowledge, understanding and skills in:
- Team work
- Problem solving
- Prioritising and managing lab resources
- Record-keeping
- Collection, analysis and interpretation of data
- Written communication.

**Subject Specific**
The module will provide students with specific knowledge, understanding and skills in:
- Handling mammalian cells
- Preparation of samples for, and acquisition of data from flow cytometry experiments
- Undertaking experiments to examine the level and localisation of expression of a target protein

**Assessment:**

| CWA: 100% | Exam: 0% |

**Details of CWA:**

- Part of the assessment will be based on the quality of the data generated.
- Students will prepare a short report of their work which will describe the work undertaken, including a critical appraisal of the outcomes along with a description of how they would change the experimental work following reflection upon these outcomes.

**Recommended texts and other learning resources:**

Bespoke Divisional Practical skills Book
MODULE NUMBER: BIOL467

MODULE TITLE: DRUG DISCOVERY - CONCEPT TO CLINIC

Number of weeks: 5  Term taught: M  Contact hours: 25  Learning hours: 150

Pre-requisites:  Co-requisites:  Credits: 15

Module organiser:  Other lecturers:
Karen Wright  Dr Anna Hart, CETAD and external contributors

Aims and scope:
This module introduces the principles involved in the discovery and development of a new drug from initial concept to the identification of a candidate compound to first use in man. This knowledge will be extended by learning how the pharmaceutical industry and small biotech companies use contemporary scientific advances to identify drug targets and develop new drugs. How new drug entities are then tested, developed and achieve market approval will also be examined using "real life" examples in the form of case studies.

Syllabus

<table>
<thead>
<tr>
<th>Day</th>
<th>Lecture Titles</th>
<th>Lecturers</th>
<th>Workshops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. Intro to Biotech and Big Pharma (Today and History)</td>
<td>KLW</td>
<td>Sim Venture</td>
</tr>
<tr>
<td>2</td>
<td>2. Core concepts in Pharmacology</td>
<td>KLW</td>
<td>CRO</td>
</tr>
<tr>
<td>3</td>
<td>3. Drug targets and Receptors</td>
<td>KLW</td>
<td>Novartis</td>
</tr>
<tr>
<td>4</td>
<td>4. Small molecules and large molecules</td>
<td>External</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5. Drug development and Preclinical studies</td>
<td>External</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6. Clinical trials (incl. Ethics)</td>
<td>AH</td>
<td>Gentronix</td>
</tr>
<tr>
<td>7</td>
<td>7. Regulatory issues</td>
<td>CETAD</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8. Biomarker Discovery</td>
<td>External</td>
<td>GSK</td>
</tr>
<tr>
<td>9</td>
<td>9. Stem Cell technologies</td>
<td>External</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10. Future perspectives</td>
<td>KLW</td>
<td></td>
</tr>
</tbody>
</table>

Learning Outcomes:

Generic Outcomes

1. Improve skills in information retrieval.
2. Develop critical analytical skills of scientific and medical data.
3. Present scientific findings in both a written and oral format.

Subject Specific

1. Describe the principal targets of drugs and how they are identified.
2. Explain the drug discovery process in terms of lead drug identification for small molecule drugs, biopharmaceuticals and natural products including the application of tools such as high throughputscreening.
3. Understand key methodologies in drug development, post lead optimisation.
4. Outline the key phases in the clinical stage of drug development.
5. Explain how the drug discovery and development process is regulated and the intellectual property issues associated with this process.
6. Describe how drug products are designed, marketed and distributed.
7. Understand trends and challenges in the biotechnology sector.

Assessment:

<table>
<thead>
<tr>
<th>Attendance 10%</th>
<th>CWA: 40%</th>
<th>Presentation: 50%</th>
</tr>
</thead>
</table>

Details of CWA and Presentation:

1) A report on a disease of unmet medical need, including the cellular and molecular basis and current treatments. This report will be a 3000-word investigation and will require extensive reading and referencing in order to convey understanding of the disease and how current treatments work and why there continues to be unmet medical need. Current evidence will be required to support their argument for this. Reports will be due at the end of Lent (W20).

2) An oral presentation of recent developments that identify and justify an appropriate drug target for discovery and development pertaining to the disease in (1). Students will be expected to make a case for their target in the context of a disease that not only has unmet medical need but exhibits a viable market for the company to invest in R+D. Handouts for the audience/examiners with key points will be expected and students will draw on the lecture material and seminar/workshops. Students will present for 15 minutes with 5 minutes Q+A to a panel of examiners during Easter exams. Presentations will be recorded (voice only) for the benefit of the external examiner. The student cohort will not be present.

Recommended texts and other learning resources:

3. Nature Reviews Drug Discovery
4. Drug Discovery Today
5. Current Opinion in Pharmacology
6. Nature Biotechnology
7. Bioentrepreneur
8. In the Pipeline http://www.corante.com/pipeline/

2013-14
**PLEASE NOTE: MODULE SUBJECT TO POSSIBLE CHANGES**

<table>
<thead>
<tr>
<th>Module number: CHIC565</th>
<th>Module title: Environmental Epidemiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weeks: 1</td>
<td>Term taught: L2 Block</td>
</tr>
<tr>
<td>Pre-requisites: None</td>
<td>Co-requisites: None</td>
</tr>
<tr>
<td>Learning hours: 100</td>
<td>Credits: 10</td>
</tr>
</tbody>
</table>

### Aims and scope:
To introduce students to statistical methods for spatial data used in environmental epidemiology. A variety of methods used to analyse spatial data will be described, including techniques for dealing with point process data and spatial count data. Methods will be illustrated by a number of published studies that look at the relationship between disease risk and environmental factors.

### Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Introduction to environmental epidemiology</td>
<td>TBC</td>
</tr>
<tr>
<td>2-3</td>
<td>Point process methods</td>
<td>TBC</td>
</tr>
<tr>
<td>4-5</td>
<td>Case-control studies and spatial clustering</td>
<td>TBC</td>
</tr>
<tr>
<td>6-7</td>
<td>Spatial count data, Poisson regression and ecological bias</td>
<td>TBC</td>
</tr>
<tr>
<td>8-9</td>
<td>Point source methods</td>
<td>TBC</td>
</tr>
<tr>
<td>10-11</td>
<td>Geostatistics</td>
<td>TBC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practical/workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Point processes</td>
<td>TBC</td>
</tr>
<tr>
<td>2</td>
<td>Spatial clustering</td>
<td>TBC</td>
</tr>
<tr>
<td>3</td>
<td>Spatial count data</td>
<td>TBC</td>
</tr>
<tr>
<td>4</td>
<td>Point source methods and geostatistics</td>
<td>TBC</td>
</tr>
</tbody>
</table>

### Learning outcomes:
- Understand the basic theory of point processes
- Use K-function methods to analyse point process data
- Understand and use methods for testing for spatial clustering of spatial case-control data
- Explain ecological bias and its effect on environmental epidemiological studies
- Analyse spatial count data using Poisson regression
- Understand and use models for analysing disease risk in relation to a point source
- Distinguish between different types of spatial data and choose appropriate methods of statistical analysis accordingly

### Assessment:
- CWA: 50%
- Exam: 50%

**Details of CWA**: Students will be asked to analyse a data-set resulting from a study in environmental epidemiology by applying methods learnt in the course, and write a report summarising the methods used and their results.

**Recommended texts and other learning resources**:
**Module Number:** ENGR503  
**Module Title:** RENEWABLE ENERGY

**Number of weeks:** 2  
**Term taught:** M2  
**Contact hours:**  
**Learning hours:** 150

**Pre-requisites:**  
**Co-requisites:**  
**Credits:** 15

**Module organise:** Dr. M.S. Campobasso  
**Other lecturers:**

**Aims and scope:**
Module aim is to introduce students to fundamentals of a range of sources of renewable energy and means of its conversion into useful forms, and to highlight technical, economical, environmental and ethical issues associated with exploitation of renewable energy sources. Course focuses particularly on most aspects of wind-, tidal- and hydro-power; many of discussed principles are applicable to most renewable energy forms.

**Syllabus**

**Introduction** to Renewable Energy: sources, economical, environmental and ethical aspects.  
**Wind Energy:** resource assessment; wind turbine types and layout; wind turbine aerodynamics; yaw control, variable-pitch, variable-speed, active and passive stall power regulation; generators; aeromechanical turbine design; cost analysis.  
**Tidal Energy:** resource assessment; tidal turbine types and layout; tidal turbine hydrodynamics; power control; cavitation; hydromechanical turbine design; cost analysis.  
**Hydropower:** resource assessment; turbine hydrodynamics; power control and turbine choice in relation to grid demands; relationship between turbine layout and characteristics of available resource; hydromechanical turbine design; cost analysis.

**Learning outcomes:**
On successful completion of this module students will:  
Be able to make estimates of energy available from wide range of renewable energy resources at given site.  
Have deeper level of knowledge/understanding of wind-, tidal- and hydro-power, including characteristics of available energy resource, detailed layout and functionality of machinery required to convert available energy resource into electricity, and relationship between characteristics of available resource and design of energy conversion system.  
Have a basic understanding of energy transmission chain and technical and economic issues associated with integrating considered energy production systems in large power grids.  
Be able to set up advanced engineering models for aeromechanical analysis and design of machinery needed for conversion of these forms of renewable energy into electricity.  
Possess basic theoretical means for performing several types of cost analysis, including assessment of cost of energy for the particular source required.  
Have familiarity with fundamental computer analysis and design tools used in modern renewable energy industry.

**Assessment:**  
**CWA:** 40%  
**Exam:** 60%

**Details of CWA:** group work

**Recommended texts and other learning resources:**
**Module Number:** FASS 507  
**Module Title:** Philosophy of the Social Sciences

<table>
<thead>
<tr>
<th>Number of weeks:</th>
<th>10</th>
<th>Term taught:</th>
<th>Michaelmas</th>
<th>Contact hours:</th>
<th>25</th>
<th>Learning hours:</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-requisites:</td>
<td>None</td>
<td>Co-requisites:</td>
<td></td>
<td>Credits:</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module organiser:** Tim Dant  
**Other lecturers:** Bronislaw Szerszynski; Vicky Singleton, David Tyfield, Claire Waterton

**Aims and scope:**
The course will provide an introduction to the philosophy of the social sciences by exploring the following questions:

- What claims to knowledge are made by science?
- Can social science make similar claims to natural science to be a science?
- What other philosophical foundations might social science use to establish its claims to systematic knowledge?
- How does social science relate to values and politics?
- How does the philosophy of social science relate to different social sciences?
- What are the strengths and weaknesses of different contemporary philosophies of social science?

**Syllabus**
Introduction
Empiricism, positivism and falsificationism
Paradigms and incommensurability
Explanation in the social sciences
Understanding and interpretation in the social sciences
Interpretive social science
Critical Social Science
Realist Philosophy of Social Science
Feminist Epistemologies

**Learning outcomes:**
On completion of this module a student should be able to:
By the end of the module, students should:

- Understand the difference between the natural and social sciences.
- Be able to discuss the philosophical basis of their own research.
- Have an understanding of the concepts of ‘empiricism’, ‘positivism’, ‘explanation’ and ‘interpretivism’ and their relationship to their own research practice.
- Understand at least two current philosophical perspectives on the practice of social science.
- Be able to demonstrate a critical understanding of how their research might constitute a claim to knowledge.

**Assessment:**  
CWA: 100 %

**Details of CWA:**
One 5000 word essay, title to be agreed with convenor

**Recommended texts and other learning resources:**

2013-14
<table>
<thead>
<tr>
<th><strong>Module Number:</strong> LLM5212</th>
<th><strong>Module Title:</strong> INTERNATIONAL ENVIRONMENTAL LAW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of weeks:</strong> 10</td>
<td><strong>Term taught:</strong> L1 &amp; L2</td>
</tr>
<tr>
<td></td>
<td><strong>Contact hours:</strong> 30</td>
</tr>
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<td><strong>Learning hours:</strong> 200</td>
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<tr>
<td><strong>Pre-requisites:</strong></td>
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<tr>
<td><strong>Module organiser:</strong></td>
<td><strong>Other lecturers:</strong></td>
</tr>
<tr>
<td>Dr Sophia Kopela</td>
<td></td>
</tr>
</tbody>
</table>

**Aims and scope:**
The course covers environmental law and policy from an international perspective. The course consists of ten weekly seminars. Each seminar will be based on a selection of readings which will form the basis for class discussions.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>International Law and Environmental Protection: the environment as a problem of international concern</td>
</tr>
<tr>
<td>2</td>
<td>Environmental governance and international law-making</td>
</tr>
<tr>
<td>3</td>
<td>General Principles of International Environmental Law and Sustainable Development</td>
</tr>
<tr>
<td>4</td>
<td>Compliance, Enforcement and Dispute Settlement</td>
</tr>
<tr>
<td>5</td>
<td>Climate change</td>
</tr>
<tr>
<td>6</td>
<td>Protection of the marine environment</td>
</tr>
<tr>
<td>7</td>
<td>Conservation of marine living resources</td>
</tr>
<tr>
<td>8</td>
<td>Sustainable use and protection of freshwater resources with an emphasis on international watercourses</td>
</tr>
<tr>
<td>9</td>
<td>Conservation of nature and biodiversity</td>
</tr>
<tr>
<td>10</td>
<td>International Trade and the Environment: Foes or Friends?</td>
</tr>
</tbody>
</table>

**Learning outcomes:**
On completion of this module students will be able to demonstrate understanding of the basic principles, sources and application of international environmental law. They will also be able to show knowledge of how international law applies to specific environmental problems.

**Assessment:**

**CWA:** 100%

**Details of CWA:**
5,000 word essay on an environmental law topic agreed with Dr Kopela.

**Recommended texts and other learning resources:**

**Aims and scope:** This course is an introduction to the field of international human rights law. The course will provide an overview of the various rights that are protected through international instruments, as well as giving a general introduction to the regional and universal systems for human rights promotion. A special emphasis to the UN human rights system and an introduction to the regional human rights protection systems will be given. The course aims to achieve both substantive and procedural knowledge of human rights protection through international systems. Contemporary issues such as human rights and development and the role of NGOs and other non-state actors will form an integral part of the course. The issues will be addressed in a manner that will be accessible for students with a law or social science background. It is understood, however, that all students will have some knowledge of general international law.

**Syllabus**

**Weekly 2hr seminars**

Topics include:

- Foundations of human rights and international human rights law
- Civil and political human rights
- Economic, social and cultural rights
- State obligations - rights justiciability
- The UN human rights system: The Charter based protection & the Convention based protection
- The Regional Human Rights Systems
- The role of non-state actors in human rights violations and protection
- Human Rights and Development

**Learning outcomes:**

On completion of this module a student should be able to:

- Demonstrate detailed knowledge and understanding of the international & regional systems for the protection and promotion of international human rights.
- Demonstrate knowledge and understanding of the nature and content regarding civil and political, social, economic and cultural rights
- Demonstrate knowledge and understanding of the nature and content of obligations
- Consider the political and social context in which international human rights law operates
- Demonstrate knowledge and understanding of contemporary issues facing international human rights law
- Demonstrate critical and analytical skills
- Demonstrate self-organisation and communication skills
- Produce well-structured coherent written and oral arguments
- Produce written work applying legal and non-legal sources in a critical manner

**Assessment:**

CWA: 100 %

**Details of CWA:** The module will be assessed by written coursework (5000 words). The coursework will assess the students’ knowledge and understanding of an area of international human rights law and of the wider context in which this field of law operates. The student should demonstrate independent research skills, critical analytical ability, the ability to construct arguments, and to reflect knowledge of primary and secondary sources through the adequate use of referencing practices.

**Recommended texts and other learning resources:**

**Core Materials:**

- UN High Commissioner for Human Rights: [www.ohchr.org](http://www.ohchr.org) (This site contains a large amount of very useful materials for the course).

**Other:**

- The American Journal of International Law
- The European Human Rights Law Review
- Human Rights Law Review
- Human Rights Quarterly
- International Human Rights Journal
- Reports from the European Commission on Human Rights, and Judgments from the European Court on Human Rights
- The Virginia University Journal of International Law
- International Legal Materials
Aims and scope:
This course is intended to give the student an in-depth knowledge of group rights in international law. Over ten weeks we will look at the concept of the nation. We will consider the historical development of national rights and examine the current rights that peoples, minorities and indigenous peoples have in international law and how they relate to democratic governance, economics and the environment.

Syllabus

<table>
<thead>
<tr>
<th>Seminar</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction: An Overview of the Rights of Peoples</td>
</tr>
<tr>
<td>2</td>
<td>The Nation as a Concept</td>
</tr>
<tr>
<td>3</td>
<td>The History of the Nation-State and National Self-determination</td>
</tr>
<tr>
<td>4</td>
<td>Colonies and International Territorial Administration</td>
</tr>
<tr>
<td>5</td>
<td>Minorities and Multiethnic Democracy</td>
</tr>
<tr>
<td>6</td>
<td>Indigenous Peoples</td>
</tr>
<tr>
<td>7</td>
<td>Economics and the Environment</td>
</tr>
<tr>
<td>8</td>
<td>Secession</td>
</tr>
<tr>
<td>9</td>
<td>Drawing Borders</td>
</tr>
<tr>
<td>10</td>
<td>Freedom Fighters, Terrorists and Humanitarian Intervention</td>
</tr>
</tbody>
</table>

Learning outcomes:
On completion of this module a student should be able to demonstrate a clear understanding of the legal concepts of people, minority and indigenous people and the inherent political and legal tensions in such categories. Show a clear appreciation of the rights of these groups and, in particular, the relationship between these rights and other legal principles and the broader context in which they operate. Be able to apply these aspects to practical examples.

Assessment: CWA: % Exam: % Module Test: %

Details of CWA:
An essay of 5,000 words on a topic agreed with Dr. Summers.

Recommended texts and other learning resources:
### Module Title: Right to Adequate Food as a Human Right

<table>
<thead>
<tr>
<th>Module number: LLM 5237</th>
<th>Module title: Right to Adequate Food as a Human Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weeks: 10</td>
<td>Term taught: Lent</td>
</tr>
<tr>
<td>Pre-requisites: None</td>
<td>Contact hours: 20</td>
</tr>
<tr>
<td>Credits: 20</td>
<td>Learning hours: 200</td>
</tr>
<tr>
<td>Co-requisites:</td>
<td>Co-requisites:</td>
</tr>
<tr>
<td>Module organiser:</td>
<td>Other lecturers:</td>
</tr>
</tbody>
</table>

#### Aims and scope
The right to adequate food is one of the fundamental human rights and this module will have its foundation in international human rights law, but will go beyond the legal framework and address the right to adequate food as part of broadly defined food security. The module will also address this right, from a political, social and environmental perspective.

#### Syllabus

**Seminars** (weekly)

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic 1: The Right to Food as part of Economic, Social and Cultural Rights (one week)</td>
</tr>
<tr>
<td>Topic 2: The normative content of the right to adequate food (one week)</td>
</tr>
<tr>
<td>Topic 3: Obligations and accountability related to the right to adequate food (one week)</td>
</tr>
<tr>
<td>Topic 4: The right to adequate food and food security (one week)</td>
</tr>
<tr>
<td>Topic 5: National implementation of the right to adequate food (one week)</td>
</tr>
<tr>
<td>Topic 6: Case studies: (five weeks)</td>
</tr>
<tr>
<td>Violations of the right to food (focus on situations where the right to food has been actively interfered with through state action or omission)</td>
</tr>
<tr>
<td>Food assistance and the right to food (issues of market distortion and failure to provide food security)</td>
</tr>
<tr>
<td>Land grabbing and the right to food</td>
</tr>
</tbody>
</table>

- **Learning outcomes:** On successful completion of this module students will be able to...
  - Demonstrate detailed understanding of the normative content of the right to adequate food.
  - Demonstrate detailed understanding of corresponding state obligation on national and international levels
  - Consider the right to adequate food implications of national and international policies.
  - Identify obligation-holders in relationship to the right to adequate food.
  - Apply principles of the right to adequate food in a comparative manner towards other economic, social and cultural human rights
  - Consider situations of violations or non-fulfilment of human rights obligations
  - Demonstrate critical and analytical skills
  - Demonstrate self-organisation and communication skills
  - Produce well-structured cohem suent written arguments
  - Produce written work applying legal and non-legal sources in a critical manner

#### Assessment:
- CWA: 100%

**Details of CWA:**
The module will be assessed by written coursework (5000 words). The coursework will assess the students’ factual knowledge of the right to adequate food as a human right set in the context of a contemporary social, political, economic, or legal setting. The student should demonstrate independent research skills, critical analytical ability, the ability to carry arguments, and to reflect knowledge of primary and secondary sources through the adequate use of referencing practices.

#### Recommended texts and other learning resources:
- Kent, George, *Freedom from want: the human right to adequate food*, Washington DC Georgetown University Press, 2005
- *The right to food guidelines: information papers and case studies*, Rome, FAO, 2006
- Skogly, Sigrun and Amanda Cahill "The Human Right to Adequate Food and to Clean and Sufficient Water", with Amanda Cahill, in van Bueren, Geraldine *Freedom from Poverty*, Paris, UNESCO,2010 pages 133 - 138
- Windfuhr, Michael Beyond the Nation State: Human Rights in Times of Globalisation*, Global Publications Foundation, 2005

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*2013-14*
# Environmental Law

**Module Number:** LLM 5238  
**Module Title:** Environmental Law

<table>
<thead>
<tr>
<th>Number of weeks: 10</th>
<th>Term taught: Lent</th>
<th>Contact hours: 20</th>
<th>Learning hours: 200</th>
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</thead>
<tbody>
<tr>
<td>Pre-requisites: None</td>
<td>Co-requisites:</td>
<td>Credits: 20</td>
<td>Other lecturers:</td>
</tr>
</tbody>
</table>

**Module organiser:** Dr Ben Mayfield

**Aims and scope:** This module will examine the way in which the sources and principles of English and European environmental law have developed, and will investigate the efficacy and effect of environmental law. In particular, students will study the sources, history and wider context of English and European environmental law. The module builds upon this study to explain how the aqueous, atmospheric and terraneous environments are protected by these laws.

## Syllabus

### Seminars (weekly)

<table>
<thead>
<tr>
<th>Part One: Seminars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic 1: Introduction to Environmental Law</td>
</tr>
<tr>
<td>Topic 2: Sources and Principles of Environmental Law</td>
</tr>
<tr>
<td>Topic 3: Environmental protection and the common law</td>
</tr>
<tr>
<td>Topic 4: The role of market mechanisms in environmental protection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Two: Student-Led Seminars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic 5: Conservation of nature &amp; the countryside</td>
</tr>
<tr>
<td>Topic 6: Water Pollution Control</td>
</tr>
<tr>
<td>Topic 7: Contaminated Land</td>
</tr>
<tr>
<td>Topic 8: Atmospheric pollution control</td>
</tr>
<tr>
<td>Topic 9: Renewable energy and the law</td>
</tr>
<tr>
<td>Topic 10: Waste management and disposal</td>
</tr>
</tbody>
</table>

### Subject Specific

On successful completion of this module students will be able to:

a. Demonstrate a clear understanding of the sources of English and European environmental law.

b. Demonstrate an understanding of the key principles of English and European environmental law.

c. Demonstrate a clear understanding of the way in which the law protects the environment.

d. Appreciate the breadth and effect of environmental law.

e. Apply this knowledge and understanding to the analysis of practical examples.

f. Solve legal problems through the application of the principles of environmental law.

g. Present legal arguments in the field of environmental law.

### General

On successful completion of this module students will be able to:

a. reflect on and appraise their own academic and professional achievements.

b. approach independent research and academic writing with confidence.

c. use their presentational skills in a variety of forms to convey complex arguments to a variety of audiences.

d. research and identify appropriate materials available in libraries and on databases, demonstrating good academic practice that relates to salient information handling and processing.

e. demonstrate their ability to organise their time and to meet deadlines.

f. demonstrate competence in interacting within a collaborative online learning environment.

### Assessment: CWA: 100%

**Details of CWA:**

The module will be assessed by written coursework (5000 words). The coursework will assess the students’ knowledge of the sources, principles and effect of English Environmental Law. The student should demonstrate independent research skills, critical analytical ability, the ability to carry arguments, and to reflect knowledge of primary and secondary sources through the adequate use of referencing practices.

### Recommended texts and other learning resources:


Further reading will be recommended for each seminar.

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2013-14
### Module Number: MATH563

<table>
<thead>
<tr>
<th>Number of weeks: 2 weeks</th>
<th>Term taught: LENT</th>
<th>Contact hours: 20</th>
<th>Learning hours: 100</th>
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</thead>
<tbody>
<tr>
<td><strong>Pre-requisites:</strong> basic statistics/probability</td>
<td><strong>Co-requisites:</strong></td>
<td><strong>Credits:</strong> 10</td>
<td></td>
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</table>

**Module Title:** CLINICAL TRIALS

**Module organiser:** Deborah Costain

**Other lecturers:**

**Aims and scope:**

Clinical trials are planned experiments on human beings designed to assess the relative benefits of one or more forms of treatment. For instance, we might be interested in studying whether aspirin reduces the incidence of pregnancy-induced hypertension; or we may wish to assess whether a new immunosuppressive drug improves the survival rate of transplant recipients.

This course aims to introduce students to aspects of statistics, which are important in the design and analysis of clinical trials. By the end of the course students should understand the basic elements of clinical trials, be able to recognise and use principles of good study design, and be able to analyse and interpret study results to make correct scientific inferences.

**Syllabus**

- This course combines the study of technical methodology with discussion of more general methodological and ethical issues.

- The course begins with a discussion of the relative advantages and disadvantages of different types of medical studies. The basic aspects of clinical trials as experimental designs are then discussed. This includes sections on good design, ethics and defining and estimating treatment effects: both continuous and binary outcome measures are considered.

- Furthermore, cross-over trials, sample size determination, and equivalence and non-inferiority trials are covered. Finally, other relevant topics such as meta-analysis and accommodating confounding at the design stage are briefly discussed.

- The teaching is intensive consisting of 20 hours over four days.

- The project is completed in the week immediately following the course.

**Learning outcomes:**

By the end of the module students should understand the basic elements of clinical trials, be able to recognise and use principles of good study design, and be able to analyse and interpret study results to make correct scientific inferences.

**Assessment:**

<table>
<thead>
<tr>
<th>CWA: 50%</th>
<th>Exam: 50%</th>
</tr>
</thead>
</table>

**Details of CWA:**

- In depth project looking at statistical, methodological and ethical issues related to the design and analysis of clinical trials.

**Recommended texts and other learning resources:**

- S. Senn, Cross-over trials in clinical research, Wiley, 1993.
- ICH Harmonised Tripartite Guidelines.
Module Number: MATH564  
Module Title: Principles of Epidemiology

Number of weeks: 2  |  Contact hours: 20  |  Learning hours: 80  
Pre-requisites: A level calculus (differentiation) and basic statistical methods including logistic regression  |  Co-requisites: Computing (in R)  |  Credits: 10

Module organiser: Dr Gillian Lancaster  
Other lecturers:

**Aims and scope:**
Epidemiology is the study of the distribution and determinants of disease in human populations. This course provides an introduction to the principles and statistical methods of epidemiology.

Various concepts, study designs and strategies used in epidemiological studies are examined. Most inference will be likelihood based, although the emphasis is on conceptual considerations.

**Syllabus**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction, measuring disease and study design</td>
</tr>
<tr>
<td>2</td>
<td>Cohort studies</td>
</tr>
<tr>
<td>3</td>
<td>Case-control studies including match design</td>
</tr>
<tr>
<td>4</td>
<td>Diagnostic test studies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practical/workshop</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Epidemiology of breast cancer (guest speaker)</td>
</tr>
<tr>
<td>2</td>
<td>Standardisation</td>
</tr>
<tr>
<td>3</td>
<td>Critical appraisal of a paper</td>
</tr>
<tr>
<td>4</td>
<td>Screening exercise and paper</td>
</tr>
</tbody>
</table>

**Learning outcomes:**
On completion of this module a student should be able to:

- Appreciate the history of epidemiology and the role of statistics
- Define measures of health and disease: incidence, prevalence and cumulative incidence risk
- Describe different types of epidemiological studies: Randomized controlled trials, cohort studies, case-control studies, cross-sectional and ecological studies, and their advantages and disadvantages
- Understand causation in epidemiology
- Explain potential errors in epidemiological studies: selection bias, confounding
- Apply remedies for dealing with confounding: Standardized rates, stratification and matching
- Calculate appropriate measures for assessing the validity of diagnostic tests and other methods of measurement in screening for disease

**Assessment:**
CWA: 50%  |  Exam: 50%

**Details of CWA:**
Data analysis and written report.

**Recommended texts and other learning resources:**


2013-14
### Aims and scope
To describe several modern genomics technologies in their biological context, to describe the types of data that are obtained from these technologies, to describe the statistical methodologies used to analyse such data and to have the students use statistical packages to perform such analyses on example data sets and interpret the results.

### Syllabus

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Introduction</td>
<td>Online</td>
</tr>
<tr>
<td></td>
<td>Sequencing</td>
<td>Online</td>
</tr>
<tr>
<td></td>
<td>The multiple testing problem</td>
<td>Online</td>
</tr>
<tr>
<td></td>
<td>Single nucleotide polymorphisms</td>
<td>Online</td>
</tr>
<tr>
<td></td>
<td>Microarrays</td>
<td>Online</td>
</tr>
<tr>
<td></td>
<td>Proteomics</td>
<td>Online</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practical/workshop</th>
<th>Title</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Genomics in R</td>
<td>Thomas Jaki</td>
</tr>
</tbody>
</table>

### Learning outcomes:
On completion of this module a student should be able to:

- identify the appropriate methods for analysing genomic data
- analyse different types of genomic data
- discuss the question of interest and the statistical findings with a non-statistician

### Assessment:
CWA: 100 %

Details of CWA:
- 10% Quizzes
- 40% Lab-sheets
- 50% Project

### Recommended texts and other learning resources:
Aims and scope: The aims of this course are:

- to examine the role that sociology and social theory can play in understanding environmental problems and conflicts;
- to explore the range of different approaches that have been developed in environmental sociology, and clarify what is at stake in the differences of approach;
- to explore how the sociological study of environmental issues can shed light on questions concerning the relations between humanity and nature, knowledge and politics, and the dynamics of environmental and socio-technical change.

Course approach
After exploring the major approaches in environmental sociology, we will explore how such approaches can help us understand the political, social and cultural dynamics operating in politically challenging domains such as climate change, resource extraction (including fracking), alternative agro-food networks, liveable cities, biotechnology and nuclear power.

Syllabus
Topics covered:
- Introducing environmental sociology
- Understanding environmentalism
- What makes an environmental issue an environmental issue?
- Whose knowledge, whose environment?
- ‘Risk Society’
- Can there be a green capitalism?
- Living in ‘the Anthropocene’
- Is this the end of ‘Nature’?
- Case study - e.g. resource extraction, fracking, nature and identity
- Case study - e.g. waste cycles and enrichment ecologies

Assessment:
CWA: 100%

Details of CWA:
One long research essay of up to 5,000 words.

Recommended texts and other learning resources:
General Reading
Giddens, Anthony 2009 The Politics of Climate Change. Cambridge: Polity
Aims and scope:
- To examine the role that sociology and social theory can play in understanding ecological and conservation thinking.
- To explore the multiple roots of the very ideas underpinning ecology and conservation - for example, ecology as material interactions in nature, ecology as prescription for conservation action and societal relations, ecology as political and social movements.
- To trace the different ways in which conceptions of society inform ecology and the conservation practices associated with it.
- To explore the ways in which ecological and conservation practices shape and re-shape nature-society relationships in material, spatial, political and ethical ways.

Course approach
- The main approach of the course is to give students the confidence and skills to think critically about the ways in which ecology and conservation both reflect and perform particular orderings of nature and society.

Syllabus
Topics covered:
- Introduction: the roots of ecological and conservation thinking
- Ideas of nature within ecology
- Models of conservation
- ‘Saving’ modern nature
- Colonial natures
- Global natures: models, databases and digitisation
- Glocal natures: participation and cultural diversity
- Conservation and capital
- Field trip: new ‘naturecultures’
- Affective ecologies

Assessment: CWA: 100%
Details of CWA:
One research essay of up to 5,000 words.

Recommended texts and other learning resources:
General Reading
Aims and scope: This module is designed to introduce students to the (inter-)discipline of Science and Technology Studies (STS) and to the variety of research undertaken within STS. It will introduce them to the major theoretical approaches for understanding and explaining scientific knowledge and technological change; encourage them to explore the implications of these approaches for the analysis, including the political analysis, of science and technology, and to consider the implications of these approaches for the status of explanation, and the character of explanations appropriate to the social analysis of science and technology.

Syllabus

Lecture/ Seminar Topics

- Introduction to STS
- Enculturation or Science as Culture
- Knowledge Shaping and Social Interests
- Modest Witnessing: the Gendering and Classing of Science
- Building Knowledge, Building Reality: Discourse, ANT, and the Dissolution of the Social
- Narratives and Sociotechnical Relations: Cultural Studies of Science and Technology
- Situated Knowledges and Cyborg Visions: Knowing as Partial Connection
- Science, Technology and Ethics
- Post-Colonial Science and Technology Studies: Ontological Politics

Learning outcomes:

On completion of this module a student should:

- Have a working knowledge of the major approaches to technology and science in STS, and the debates between these different positions.
- Have explored the way in which different theoretical approaches may be applied to exemplary case materials.
- Understand how different approaches to analysis imply political and epistemological presuppositions.
- Have developed the capacity to criticise different approaches to science and technology studies, and have the initial knowledge necessary to develop and justify your own approaches.

Assessment:

- CWA: 100%
- Exam: %
- Module Test: %

Details of CWA: 1 Research Essay @ 5,000 words - title tbc

Recommended texts and other learning resources:

Aims and scope:
This is a course about social theory with emphasis on three main topics: an investigation of the nature of the object of social theory, that is, “the social”; methodological issues related to this investigation; and the relationship between social theory and (post)modernity. The course aims to critically examine the ways in which different social theoretical perspectives approach their objects, and to consider the consequences of these differences. The focus will be on the newer social theories.

Syllabus

Lecture

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General introduction to the course</td>
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<tr>
<td>2</td>
<td>Modernity as differentiation: Bourdieu and Luhmann</td>
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<tr>
<td>3</td>
<td>Ambivalence, modernity and social theory: Bauman</td>
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<tr>
<td>4</td>
<td>Sociality with objects: Latour’s actor-network theory</td>
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<td>5</td>
<td>Empire: from Deleuze to Negri</td>
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<td>6</td>
<td>Zones of indistinction: Agamben’s “camp”</td>
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<tr>
<td>7</td>
<td>Social fantasy: Lacanian social theory</td>
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<tr>
<td>8</td>
<td>Critical theory and the theory of critique</td>
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<tr>
<td>9</td>
<td>Student presentations</td>
</tr>
<tr>
<td>10</td>
<td>Mobile Sociologies</td>
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</tbody>
</table>

Learning outcomes:

Assessment:  
CWA: %  
Exam: %  
Module Test: %

Details of CWA:  
One 5,000 word essay to be submitted in the first week of the Lent Term.

Recommended texts and other learning resources:

Speed and Politics, Cambridge, MA: MIT Press
Urry, J (2000) Sociology Beyond Societies (Routledge)
### Module Number: SOCL 930

**Module Title:** Policy, Publics and Expertise  
**Number of weeks:** 3 weeks  
**Term taught:** Lent  
**Contact hours:** 25  
**Learning hours:** 200  
**Pre-requisites:**  
**Co-requisites:**  
**Credits:** 15 or 20  
**Module Organiser:** Dr David Tyfield  
**Other Lecturers:**

### Aims and Scope:
- Demonstrate a critical understanding of policy and administrative worlds (in selected domains, such as science, technology, environment and new media) and trace their changing relationship to expertise and publics;  
- Appraise and value the relationship between policymaking and different forms of knowledge and expertise, both codified and uncodified;  
- Understand the significance of debates surrounding the interaction of scientific and technological expert and public knowledges in their historical and cultural context and assess their relevance and use for contemporary policy issues.

### Course Approach:
This module will introduce the last 30 years of debates regarding expert knowledge and lay understanding in relation to policy making, and how new ways of thinking about policy (e.g. for science, technology and climate change) are beginning to inform broader policy processes and experiments in the governance of today’s highly technoscientific societies.

### Syllabus - Topics Covered:
- Introduction - What is Policy? (1) - Government, Governance and Globalisation.
- What is Policy? (2) - Comparative and Interpretive Perspectives.
- Experts and Expertise.
- Demonstrating Truth: the Staging of Science.
- The State and its Population.
- The State and its Publics.
- When Experts Disagree.
- Performing Publics.
- Neoliberal Governance.
- Policy as Experiment - the Case of Climate Change.

### Assessment:
- **CWA:** 100%
  
**Details of CWA:**
One research essay of up to 5,000 words.

### Recommended Texts and Other Learning Resources:
**General Reading**

2013-14
Number of weeks: 10
Term taught: L1 & L2
Contact hours: 25
Learning hours: 200

Pre-requisites:
Co-requisites:
Credits: 15 or 20

Module organiser: Claire Waterton

Aims and scope:
- To explore a range of interpretative methods for analysing the social, cultural, political and technical aspects of environmental change.
- To explore and understand the different contexts in which analysis of contemporary environmental change occurs (e.g. activism, campaigning, media, public policy).
- To learn how to select appropriate methodological tools for different analytical uses and contexts.
- To recognise the limits and performative effects of our own methods and therefore address issues of accountability and responsibility of the analyst.

Course approach:
This course is designed to familiarise students with a range of ways of thinking about and analysing the social, cultural and political relations involved in environmental change. It draws upon a rich vein of theory and practice within the sociological sub-discipline of Science and Technology Studies (STS), an area of research that is a particular strength at Lancaster University.

Syllabus - Topics covered:

Week 1: STS theory and method for understanding environmental change
Week 3: Ethnographic studies
Week 2: The case study
Week 4: Analysing discourse, metaphor and power
Week 5: The gendered politics of environmental issues
Week 6: Technologies and users
Week 7: Postcolonialism and environmental change
Week 8: Art, activism and environmental change
Week 9: Researching and representing the public
Week 10: Materialities and the responsibilities of method

Assessment: CWA: 100%
Details of CWA:
A notebook based on each week’s reading to be prepared by each student
One (10 minute) verbal presentation in class
One 3000 word essay

Recommended texts and other learning resources:

General Reading
Ruth Wodak and Michal Krzanowski (eds.) Qualitative Discourse Analysis in the Social Sciences (Basingstoke, Palgrave 2008).

2013-14
Aims and scope: Introduce debates on (a) the nature of capitalism, its phases, varieties, and global articulation; (b) whether it is inherently prone to crisis or merely contingently so and what forms of crisis are characteristic of capitalism; (c) the nature of the contemporary crisis in capitalism, its periodization, differences in its dynamics across so-called varieties of capitalism, and its broader economic, political, and socio-cultural repercussions; and (d) the question of the governability of capitalism, crisis-management, and crises of crisis-management.

Course approach: The historical and geographical scope of the course depends on student interests and current events as well earlier developments in capitalism in different countries. Participants are expected to follow one blog and to read a serious newspaper to follow the evolving course of the current economic crises.

Syllabus: Topics covered:
- Introduction
- What is capitalism?
- Marx, Weber, Schumpeter
- Crisis and Crisis-Tendencies
- The Global Financial Crisis
- Fiscal and Sovereign Debt Crises
- Are Crises Inevitable, Can They be Managed?

Assessment: CWA: 100%

Details of CWA:
One Short assignment and a longer essay

General Reading:
**Module Number:** SOCL 944  
**Module Title:** Interdisciplinarieties: Environment, Culture and Society  
**Number of weeks:** 10  
**Term taught:** Michaelmas and Lent  
**Contact hours:** 25  
**Learning hours:** 200  
**Pre-requisites:**  
**Co-requisites:**  
**Credits:** no credits  
**Module organiser:** Dr Claire Waterton  
**Other lecturers:** Tbc.

### Aims, scope and approach:
This is a non-assessed module that runs through the Michaelmas and Lent Terms to address issues arising for students on the MA and MSc Environment, Culture and Society from working across disciplinary boundaries.

It will be run as a 2 hour workshop taking place every 2 weeks, starting in week 1, where issues of skills, learning, assessment, and the relevance of interdisciplinarity working will be addressed for the whole cohort.

It is also designed to address any pastoral issues of running an MA/MSc across 2 faculties and will ensure good face to face contact between teaching staff and students.

Talks will be given by visiting and teaching staff and materials for discussion will include the students’ own work, as well as films, journal articles, media and policy issues.

### Syllabus
**Indicative Topics:**
- Interdisciplinarity - what is it, what is its value, and how does it work?
- Challenges of interdisciplinary reading
- Challenges of interdisciplinary analysis
- Challenges of representing interdisciplinary research
- Environmental policy and interdisciplinarity
- Environmental activism and interdisciplinary research
- Interdisciplinary themes - e.g. Science and Justice
- Can interdisciplinary research travel?
- Can interdisciplinary research make a difference? To what? When? How? And for whom?

### Assessment:
No assessment

### Recommended texts and other learning resources:
**General Reading**
- Bracken L E and Oughton E A 2006 ‘What do you mean?’ The importance of language in developing interdisciplinary research *Transactions of the Institute of British Geographers* 31 371-82
- Kuhn T S 1970 *The structure of scientific revolutions* 2nd edn Chicago University Press, Chicago IL
- Robinson J 2008 Being undisciplined: transgressions and intersections in academia and beyond *Futures* 40 70-86
- Russell A W, Wickson F and Carewc A L 2008 Transdisciplinarity: context, contradictions and capacity *Futures* 40 460-72

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2013-14