Microbiology is a core biological discipline that is of profound importance for many areas of societal relevance. Within the Microbiology Department at UCC, we are currently undertaking a major curriculum review with the dual aims of providing the best undergraduate education possible to our diverse cohort of students, and of attracting high quality students to the discipline.

The third year college undergraduate programme in UCC is where students first specialise in Microbiology so we have put our initial focus into how we teach that year. The module that is the focus of this report is named ‘Molecular Microbial Ecology’, with the module code MB3005. This report deals with the redesign of this course (module) based on a Learning Outcomes strategy.

The key principle of this approach is that a course is described by what the student will be able to do following completion rather than by what the lecturer will teach during the course. This report describes the process that was followed to convert the course to learning outcomes, including defining outcomes, teaching methods, content and assessment. These aspects are all interrelated and full implementation requires their co-ordination.

### Defining Learning Outcomes

**Original Objective**

To provide detailed information on molecular microbial ecology and on soil micro-organisms, their roles and exploitation.

**Step 1: Redefine Teaching Objectives for the Course**

- Explain the importance of microbes in the environment.
- Explain the relevance of the physical, chemical and biological environment factors for microbial function.
- Describe the major classes of microbe that are present in the environment and review the types of ecological interactions that may occur between them.
- Describe the repertoire of molecular (DNA-based) and non-molecular techniques that can be used to study microbes in their environment.
- Provide a range of case studies that illustrate how important ecological interactions can be studied and exploited.

**Expanded Objective**

Following the module students should be able to:

1. Explain the general importance of microbial communities for ecosystem function.
2. Describe, using examples, different types of ecological interactions involving microbes.
3. Describe, compare and contrast the methods that can be applied to study microbes and microbial communities in the environment.
4. Explain, using examples, how diverse methods can be applied to understand microbial function in natural ecosystems.

**Step 2: Formulate Teaching Objectives as Learning Outcomes**

<table>
<thead>
<tr>
<th>Cognitive Domain: Bloom’s Taxonomy</th>
<th>Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Knowledge</td>
<td>LO 1</td>
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<tr>
<td>2. Comprehension</td>
<td>LO 2</td>
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<td>3. Application</td>
<td>LO 3</td>
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<td>4. Analysis</td>
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<td>5. Synthesis</td>
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<td>6. Evaluation</td>
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</tbody>
</table>

### Linking Outcome to Depth of Learning

**Module Content**

- Importance of microbes and microbial processes
- Biogeochemical cycles
- Nutrient cycles
- Food webs
- Ecosystem sustainability
- Importance of the environment and environmental factors
- Water, temperature, oxygen, pH

**Ecological interactions (classes of) within ecosystem**

- Methods for studying diversity and function in microbial communities
- DNA-based methods (AFLP, FRET, DGGE)
- Non-DNA methods (RAPD, PFGE)
- Genetic markers
- Isotopic methods (isotopic/SP)
- Immunocapture methods
- Molecular methods for studying diversity and function in microbial communities
- Microbial community function: nitrogen and carbon cycles
- Introduction of microbes into an environment
- Micro-organisms in soil
- Rhizosphere microbiology
- New microbial technology applied to soil
- Exploitation of soil micro-organisms

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**Teaching Methods**

- Course notes and handouts
- Primary scientific papers
- Student study: self-directed learning
- Recommended chapters in textbooks
- Scientific review articles
- 10 th Formal lectures

**Assessing Student Learning**

- Assessment must be based on defined learning outcomes
- Assessment must consider different learning outcomes
- Students of diverse abilities should be allowed to show level attained

**Part A.** Summarise the contribution of microbes to the nitrogen cycle. (LO1, LO2)

**Part B.** Describe how modern molecular methods have been applied to study diversity and function in microbial communities. (LO3, LO4)

**Sample Question**

- How do modern molecular methods help us understand the diversity and function of microbes in soil ecosystems?

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**Pre-existing Module Description**

**Module Description in University College Calendar 2005-2006**

**MB3005**

Molecular Microbial Ecology

**Teaching Methods**: Eighteen 1 hour Lectures.

**Examination method**: One 1.5 hour essay paper.

**Module Objective**: To provide detailed information on molecular microbial ecology and on soil micro-organisms, their roles and exploitation.

**Module Content**: Micro-organisms in soil

- Rhizosphere microbiology
- New microbial technology applied to soil
- Exploitation of soil micro-organisms