The University Of Sheffield.

Department of Molecular Biology & Biotechnology

MBB340 The Microbiology of Extreme Environments

Module Handbook 2019-20

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MBB340 is a 10-credit module, taught in semester 2A

Module Description

The overall aim of this module is to provide a detailed account of how microorganisms survive in extreme environments on Earth. The first part of the course examines a range of extreme environments including salt lakes, hot springs, polar regions, mining areas, soda lakes, deserts, hydrothermal vents and sea ice and explains the metabolic processes used to grow optimally under these extreme conditions. The growing industrial applications of extremophilic microorganisms will also be covered. The second part of the course looks at how proteins are adapted to remain stable and active under extreme conditions, since proteins readily denature under moderate heat, increased levels of salinity or changes in pH.

Module Aims

A1: build on the microbiological and protein structure topics studied in earlier modules to provide a detailed in depth account of how microorganisms survive in extreme environments on earth and the adaptation of their cellular processes and molecules to such environments;
A2: analyse and evaluate recent advances in the field of extreme environment biology.

Learning Outcomes

By the end of the module, a student will be able to:

LO1: analyse and critically discuss how the growth and survival mechanisms that microorganisms use to grow in extreme environments on Earth, such as salt lakes, hot springs, polar regions, mining areas, soda lakes, deserts, hydrothermal vents and sea ice, relate to their metabolism and physiology;
LO2: critically analyse and compare how proteins are adapted to remain stable and active under extreme conditions;

LO3: appraise and examine the techniques used and results presented in relevant scientific literature and critically analyse the material.

Syllabus

The following topics are covered in the modules and by the end you should be able to demonstrate a critical understanding of the following:

- the growth and survival mechanisms that microorganisms use to grow in extreme environments on Earth, including salt lakes, hot springs, polar regions, mining areas, soda lakes, deserts, hydrothermal vents and sea ice;

- how proteins are adapted to remain stable and active under extreme conditions.

Detailed Syllabus

Dr Jim Gilmour

The mechanisms used by microorganisms to grow in extreme environments on Earth. Definition of an extreme environment, types of extreme environments and extremophiles, biodiversity of extreme environments and importance of extremophiles. Halophiles - mechanisms of salt tolerance; low salt-in compatible solutes; high salt in Halobacteriales. Thermophiles - life at high temperature; lipids and proteins in thermophilic Bacteria and Archaea; upper temperature limit for growth. Psychrophiles - life in low temperature environments; lipids and proteins in psychrophiles; lower temperature limit for growth. Acidophiles/alkaliphiles - internal pH homeostasis; bioenergetic problems when growing at low and high pH. Piezophiles - effects of high pressure on microorganisms. Polyextremophiles - organisms that grow at more than one environmental extreme. Industrial applications of extremophiles.

Dr Pat Baker

Protein molecules are only marginally stable in normal conditions, they readily denature under moderate heat, increased levels of salinity or changes in pH. These lectures will explore, at a molecular level, how proteins from thermophiles, psychrophiles and halophiles have adapted to their extreme environments, using a number of different examples.

Teaching/Learning Activities

The module will be presented in 16 lectures, each of 50-minutes, plus two self-study sessions (lectures 3 and 6). Students may consult the module lecturers via email or at the end of a lecture. Supplementary materials will be provided either as handouts or on the MOLE page for the module.

Each student will be expected to spend at least eight hours per week clarifying and extending their understanding of the content of the module, by reading the additional literature specified and incorporating this into lecture notes. The University’s notional total time for learning and assessment in a 10-credit module is 100 hours.

It is departmental policy to make lectures available via Encore. However, this is not always possible technically and individual lecturers may have reasons for not recording some sessions.

Five top tips on how to use lecture capture effectively.

1. Attend lectures – students who attend tend to get better grades.
2. Use the captures to supplement your studies. Dip into the parts you need to enhance your knowledge and understanding.
3. Don't wait until a few days before the examination to use the captures. Space your learning throughout the semester to enhance your knowledge and understanding.
4. Don't binge watch! Again, spacing your learning across the semester is a more effective approach.
5. Watch at normal speed (if you speed the recording up you might miss key information).

Nordmann et al 2018 Lecture capture: practical recommendations for students and lecturers, Preprint DOI: 10.31234/osf.io/sd7u4

Self-Assessment

A sample question paper will be prepared and made available in Blackboard (MOLE) towards the end of the module.

Individual feedback on questions will be provided to students who submit written answers to the relevant staff member.

Module Assessment

The module will be assessed by a final written examination paper of two hour duration, held at the end of Semester 2, and covering material introduced in lectures and prescribed reading.

Reading List

Review and research articles will be recommended as the course proceeds.

Module Timetable

Your timetable can be viewed by clicking on My Timetable from the All Services menu in MUSE. You can also view your timetable via the iSheffield app. Remember to update the app regularly to ensure you are viewing the most up-to-date information.