Module Information

Module Code	Module Title	Semester	Mod. Credits
LSM3242	Translational Microbiology	2	4

Module Description

This module covers the underlying principles and wide-ranging industrial, environmental, pharmaceutical, and biomedical applications of microbiology. The objectives are (a) to gain an understanding of the role of microorganisms for biotechnology applications in the fields of medicine, agriculture, organic chemistry, synthetic biology, public health, biomass conversion, bioremediation, and biomining; and (b) to review advances in genetics and molecular biology of industrial microorganisms, enzyme engineering, environmental microbiology, food microbiology, and molecular biotechnology. A particular focus will be on the meaning and impact of microbiology on human health and the development of new therapeutic approaches.

Eligibility and requirements

Prerequisites (prior knowledge required): LSM1102/LSM1106 or basic knowledge in microbiology or molecular biology

Corequisites: NIL

Precluded modules (if any): NIL

Instructional methods

The following instructional methods will be employed:
1) Lecture
2) Tutorial
3) Blended Learning
4) Learning,Laboratory (Dry/Wet)
5) Expedition/Site/Field visit
6) Inquiry-based or Research

Assessment modes

The following assessments will be employed:

40% Continuous Assessment
1) Mid-term exam (MCQ) (20%)
2) Group work with presentation related to practical (20%)

60% Final Examination: MCQ and SAQ

Contact information for Module Coordinator and other instructors

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Course content and syllabus

Introduction

- History - Microbes and cell cultivation – Prokaryotic and eukaryotic cells
- Module overview - Co-evolution of life and minerals & Exhibition of mineral/gem specimen

Public health - Nutrition

- An 'omics' toolbox to delve into the human microbiome
- Intestinal microbiology in early life and its translation into nutritional concept: prebiotics, probiotics, and synbiotics
- From industrial microbiology to a functional dairy food with health benefits
- Visit of Danone Nutricia Research, Singapore R&D centre

Synthetic biology (Genetically engineered microorganisms)

- Basics of synthetic biology – Bacterial regulation & Key concepts
- Application & engineering of proteins
- Modern genetic technologies & Synthetic organisms

Biotechnology

- Antibiotics & enzymes
- Bio-mining/-leaching - Exhibition of metal ore specimen and gem stones
- Microbes in bioremediation
- Microbial functions in genetic therapy - Genome editing

Diagnostics & therapeutics development

- Microorganisms as gene shuttles & for therapy of human diseases

Learning activities

The following learning activities will be employed to achieve the learning outcomes of knowledge, cognitive skills, generic skills and/or attributes development stated in the 'Intended Learning Outcomes' below:

1) Debates
2) Expedition/Field Trip/Site Visit
3) Group Discussion or Discussion Forum
4) Group/Individual Presentation
5) Group/Individual Project
6) Hands-on Technology
7) Interactive Lecture
8) Laboratory Activities (Wet/Dry)
9) Peer-Learning
10) Report/Essay Writing
11) Self-Assessment or Quiz
12) Student Generated Questions

Hands on/lab practical: In teams, students attend two laboratory practicals, one about fermentation technologies and one about synthetic biology. One of the these practicals is presented by the teams followed by a question and answer. This exercise facilitates collaboration and teamwork, verbal/oral communication, data analyses and critical thinking, efficient planning and organisation.

Interactive lectures and problem based learning: The lectures are very interactive and interdisciplinary and include problem-based learning activities facilitating interdisciplinary and creative thinking, quantitative thinking and ethics awareness.

Field trip to the Danone Nutricia Research Facility: Students get to see the only artificial model of a human gut in Asia, experience the study and production of modern synbiotics, and learn about clinical trial design. This experience facilitates group discussions, interdisciplinary thinking, and gives them a flavour of planning, organisation, and management skills required in a company's environment.

Technology-supported three-stage classroom feedback system for promotion of self-regulation and assessment of student and teacher performance: Classroom feedback is essential to facilitate self-regulation and assessment of student and teacher performance. A technology-supported classroom feedback system is implemented which provides students with three different levels of feedback: First, a direct computerized quantitative feedback; second, a dialogical external feedback from peers; and third, a class-wide qualitative external feedback from the teacher. This easy to set-up three-stage classroom feedback system enables the application of several principles of good feedback practice, triggers measurable learner and teacher self-regulation and steadily improves the quality of learning and teaching.

Intended Learning Outcomes

Knowledge development

Having attended this module, students will be able to explain some of the most important applications of microorganisms in the fields of medicine, agriculture, organic chemistry,

synthetic biology, public health, biomass conversion, bioremediation, and biomining. Students will be able to make/ferment beer, to properly use basic microbiology techniques, to identify different concepts in synthetic biology, to distinguish between different genetic vectors, to explain the CRISPR/Cas genome editing technology, to differentiate between pre-, pro- and syn-biotics, and to analyse and interpret experimental data.

This module will provide the opportunities to develop the following cognitive skills, generic skills and attributes:

The students will achieve a level of integrative understanding and are trained in knowledge transformation.

Very Good Opportunities	Good Opportunities
1) Remember: Recognize, Recall & Know 2) Understand: Question, Connect & Explain 3) Apply: Use, Execute & Implement 4) Analyze: Differentiate, Organize & Attribute 5) Evaluate: Review, Check & Critique 6) Verbal/Oral Communication 7) Analytical & Critical Thinking 8) Quantitative Thinking 9) Interdisciplinary Thinking 10) Creative Thinking 11) Problem-solving & Decision-making 12) Collaboration & Teamwork 13) Planning, Organizing & Management skills 14) Self-Efficacy 15) Adaptability & Learnability 16) Resilience	1) Create: Ideate, Plan, Generate & Produce 2) Written Communication 3) Digital & Information Literacy 4) Ethics Awareness

Required and/or recommended readings

Optional, not required:

Glazer & Nikaido, Microbial Biotechnology: Fundamentals of Applied Microbiology, 2nd ed. Cambridge Univ. Press. 2007.
Lee YK. Microbial Biotechnology, Principles and Application, 2nd ed. World Scientific, Singapore. 2006.
Black JG. Microbiology: Principles and Explorations, 6th ed. John Wiley & Sons, Hoboken. 2005.