

## Module Information

Module Code	Module Title	Semester	Mod. Credits
LSM4264	Freshwater Biology	2	4

### Module Description

Fresh water is essential to life, yet constitutes less than 3% of Earth's total water. With many freshwater ecosystems under threat, understanding the biology of freshwaters is fundamentally important to their management, conservation, and restoration. This module introduces the study of inland waters, with emphasis on Singapore. Through lectures, directed readings and discussions, field trips, and project work, we will focus on topical areas including aquatic biodiversity and ecology, aquatic conservation, freshwater ecosystem services, threats to fresh waters, anthropogenic effects, sustainable water use, and policies, regulation and management of freshwater resources in local and international contexts.

### Eligibility and requirements

Prerequisites (prior knowledge required): LSM3254

Corequisites: NIL

Precluded modules (if any): NIL

### Instructional methods

The following instructional methods will be employed:

- 1) Lecture
- 2) Seminar
- 3) Expedition/Site/Field visit

### Assessment modes

The following assessments will be employed:

- 1) Class participation = 15%
- 2) Group Project proposal = 10%
- 3) Group Project Debate, readings and handouts = 15%
- 4) Individual Project Report = 20%
- 5) Final Examination = 40%

### Contact information for Module Coordinator and other instructors

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## **Course content and syllabus**

### 1a Module introduction

- o Course overview

### 1b Limnology

- o Introduction to limnology
- o Limnological techniques

### 1c Freshwater habitats

- o Classification of freshwater habitats
- o Singapore's freshwater habitats

### 1d Freshwater wetlands

- o Types of wetlands, tropical vs. temperate wetlands, hydrology, ecology

## 2 Freshwater biodiversity

- o Classifying limnological diversity
- o Examples of diversity: Freshwater crabs, phytoplankton, zooplankton

## 3 Freshwater ecology

- o Trophic cascades, biomanipulation alternate stable state, food web studies, electrofishing methods

### 4a Threats to fresh waters: pollution and climate change

- o Eutrophication, Pollution (metals, plastics), climate change impacts on freshwater systems

### 4b Threats to fresh waters: aquatic invasive species

- o Introducing invasive species, invasion process and pathways, management of invasive species, aquatic invasive species in Singapore

### 5a Aquatic conservation and human water use

- o Conceptual framework, freshwater ecosystem services, human water use, sustainable water use in Singapore

### 5b Freshwater biodiversity conservation

- o Focusing conservation efforts
- o Effective conservation strategies
- o Future of freshwater biodiversity conservation

## **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) Case Studies                     | 6) Interactive Lecture  |
| 2) Critical Reading & Critique      | 7) Peer Review and Feedback (including Group Review & Feedback) |
| 3) Debates                          | 8) Problem-based Learning                                       |
| 4) Expedition/Field Trip/Site Visit | 9) Report/Essay Writing   |
| 5) Group/Individual Project         |   |

Interactive Lectures/case studies will achieve Intended Learning Outcomes (ILO) 1–5. Guest Lectures will achieve ILO 2–5 by providing students with a broader perspective of freshwater issues.

Student debates/problem based learning will achieve ILO 4–7 as they have to read and critique literature for their debates.  
 Fieldwork sessions will achieve ILO 1–4 as it exposes students to the actual habitats that are covered in the module.  
 Peer Review for debates will achieve ILO 5–7 as students will be able to give their classmates feedback and help them to improve their public speaking.  
 Report writing will achieve ILO 6–7 as students will need to read, analyse and synthesise all the findings from each of the debate topics into one coherent essay.

**Intended Learning Outcomes**

**Knowledge development**

- 1) Recognise and explain the scope and relevance of freshwater biology
- 2) Identify, compare and contrast the structure and function freshwater habitats
- 3) Identify and discuss the diversity and ecological roles of major groups of freshwater organisms, and be aware of techniques for sampling them
- 4) Appreciate and discuss various freshwater ecological processes of topical and/or local interest
- 5) Appreciate and discuss key issues in aquatic conservation of topical and/or local interest
- 6) Synthesise information to analyse and understand the role of science in informing aquatic conservation policy and management
- 7) Critically and constructively evaluate scientific papers and oral presentations; and better communicate ideas and information verbally and through writing

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

Very Good/Good Opportunities	Good/Average Opportunities
<ol style="list-style-type: none"> <li>1) Verbal/Oral Communication</li> <li>2) Interdisciplinary Thinking</li> <li>3) Collaboration &amp; Teamwork</li> <li>4) Planning, Organizing &amp; Management skills</li> </ol>	<ol style="list-style-type: none"> <li>1) Written Communication</li> <li>2) Digital &amp; Information Literacy</li> <li>3) Analytical &amp; Critical Thinking</li> <li>4) Creative Thinking</li> <li>5) Problem-solving &amp; Decision-making</li> <li>6) Ethics Awareness</li> <li>7) Self-Efficacy</li> <li>8) Adaptability &amp; Learnability</li> <li>9) Resilience</li> </ol>

**Required and/or recommended readings**

- Dodson S, 2004. Introduction to Limnology. McGraw-Hill
- Dodds WK, 2002. Freshwater Ecology: Concepts and Environmental Applications. Academic Press
- Dudgeon D (ed.), 2008. Tropical Stream Ecology. Academic Press

- Yeo DCJ, Wang LK, Lim KKP, 2010. Private Lives: An Exposé of Singapore's Freshwaters. Raffles Museum of Biodiversity Research
- Yeo DCJ, Lim KKP, 2011. Freshwater Ecosystems. In: Ng PKL, Corlett RT, Tan HTW (eds.) Singapore Biodiversity: An Encyclopedia of the Natural Environment and Sustainable Development. Raffles Museum of Biodiversity Research. Pp. 52–63.