Microbial Physiology: expected knowledge level MSc students Life Science and Technology at TU Delft, version 2017

We expect students who enrol in the MSc programme "Life Science and Technology" to have a level of knowledge and understanding of microbial physiology equivalent to a serious, specialized BSc course.

An indication of the required level of understanding is given by the paragraphs of the course book "Brock – Biology of Microorganisms (Madigan and Martinko, 14th edition) that are part of the exam material for TU Delft's BSc course in Microbial Physiology and by the accompanying two hand-outs on chemi-osmotic coupling and thermodynamics of microbial growth.

In addition to this material, we expect students to be comfortable with the following aspects of microbial physiology:

- Basic microbial growth kinetics (Monod kinetics for specific growth rate and specific consumption rate of the growth-limiting nutrient)
- Maintenance energy requirements (Herbert-Pirt equation and its implications)

In the lists below, paragraphs in "Brock – Biology of Microorganisms" indicated as "**recommended reading"** are expected to be fully known, except for the **"review of key terms"** in these paragraphs.

Introduction and Thermodynamics of microbial metabolism

Learn/master

- Introduction and History	Chapter 1
- Microbial Diversity	3.3
- Microbial Morphology	2.5-2.6
- Free energy	3.4-3.5, Appendix 1
- Thermodynamics of redox reactions	3.6, Appendix 1
- Aerobic respiration	3.10-3.11
- Proton motive force vs. ATP	3.7
- Solute transport: secondary transport	2.7-2.9

Recommended reading (learn 'review of key terms')

- Prokaryotic Diversity, Eukaryotic Microorganisms	2.10-2.22
- Microscopy and Cell Morphology	2.1-2.4

Fermentation/diversity in sugar metabolism

Learn/Master

- Nutrition and culture of microorganisms (zelfstudie)	3.1-3.2
- Main pathways of sugar metabolism	3.8

- Fermentative pathways starting from pyruvate — 15.3, 13.11-13.13
- Interspecies hydrogen transfer (syntrophy) — 13.15
- Chemiosmosis in fermentation processes — 13.14
- The alternative: respiratory sugar dissimilation — 3.12
- Exercises on Fermentation Processes — lecture slides
- Toxic forms of oxygen — 5.16

Recommended reading (learn 'review of key terms')

- Biosynthesis — 3.14-3.16
- Prokaryotic Diversity: the Bacteria — Chapter 14 and 15

Nutrient-limited growth

Learn/Master

- Growth of bacterial populations (zelfstudie) — 5.5-5.6
- Measuring microbial growth (zelfstudie) — 5.8-5.10
- Nutrient-limited growth: the chemostat — niet 5.7 (bevat fouten)

Recommended reading (learn 'review of key terms')

- Environmental factors — 5.11-5.16

Respiration

Learn/Master

- Respiration: thermodynamic constraints — 3.10-3.12, Appendix 1
- Inorganic electron donors: lithotrophic growth — 3.13, 13.6-13.10
- Autotrophic growth: the Calvin cycle — 13.5
- Autotrophic CO_2 fixation: other options (zelfstudie) — 13.5
- Reverse electron transport — 13.3 + lecture slides
- Anaerobic respiration — 3.13, 13.16-13.21

Recommended reading (learn 'review of key terms')

- Molecular oxygen as a reactant — 13.22
- Cell inclusions — 2.14
- Prokaryotic Diversity: the Archaea — Chapter 16

Nutrient-limited growth (continued)

Learn/Master

- Growth in the natural environment — 19.1-19.5
- Soil and freshwater microbial habitats — 19.6-19.8
- Marine microbiology — 19.11-19.13, 22.12

Microbial cycles of the elements

Learn/Master

- The Carbon cycle — 13.23-13.24,20.1-20.2

	20.8,21.4-21.5,22.7
- The Nitrogen cycle	3.17,14.3,20.3,22.3
- The Sulfur cycle	20.4
- The Iron cycle	20.5
- The phosphorus, calcium and silica cycles (zelfstudie)	20.6
- Leaching processes	21.1-21.2
- Enrichment cultures	18.1-18.2

Recommended reading (learn 'review of key terms')

- The human microbiome	22.8