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MOL300 Practical Biochemistry and Molecular Biology (20 ECTS)

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MOL300 is a master-level lab-based course, and the main enrolment comes from incoming MSc students majoring in molecular biology for whom the course is mandatory. Occasionally, non-MSc students such as exchange students, PhD students and technicians who want to brush up their lab skills also take the course. The enrolment in the last five years were 24 (2020), 16 (2021), 14 (2022), 15 (2023), 22 (2024), respectively. (MOL300 has a practical maximum capacity of 24.) MOL300 students are required to perform project-oriented experiments, and to write a full scientific report after each lab topic.

The main objective of MOL300 is to equip students with basic knowledge and practical experience in modern molecular biology and biochemistry. The course has two main areas: hands-on experience and report writing. Neatly woven lab plans allow students to perform as many experiments as possible. Students also receive intensive training in report-writing, with help from the teaching staff, which includes detailed feedback on submitted reports.

MOL300 has the following goals: 1) to plan and conduct experiments, 2) to document the experimental results and analyse the data, 3) to learn to communicate the results, both orally and as a written report. In all, the course aims for students to be well-versed in both hands-on skills and scientific communication skills.

MOL300 students conduct various experiments in the areas of protein biochemistry, gene technology and cell culture. Prior to each lab exercise (or module), a flow chart, a summary of what they will do in the lab is required. Flowcharts help students to prepare for their conducting experimental steps and understanding of ‘the theories’ behind the topics. Experiments are to be carried out by the student themselves whenever possible, with close supervision by the teaching staff. There are also Q&A sessions that answer and discuss practical and relevant issues, such as data-gathering and analysis.

Students will submit a total of six IMRaD-modelled scientific reports. In addition, students are required to write a lab journal, which is a primary source of experimental results and data analysis. Since 2023, the first two reports have been student-peer reviewed and the remaining four reports have been thoroughly reviewed and commented on by the teaching staff. The quality of the reports, which is a measure of student accomplishments, has increased gradually as the course proceeded. The overall understanding of the subjects that have been covered in MOL300 is tested by a written exam at the end of the semester.

MOL300 gives a formal letter-based grade, which is based on a written exam (aka, ‘school exam’, 70%) and a combined report evaluation (30%). (From 2025, it will be changed to a 60% exam and 40% report system.) This bifurcated evaluation scheme was first used in MOL300 and is to date one of the most thorough and fair evaluation form used in the evaluation of a traditional lab-based practical course. The proportion of the A and B grades in MOL300 is about 40-60% (of which A, 10-20% and B, 30-40%). There is a clear correlation between the report grades and the written exam grades: that is, students who had done well in the report writing also did well in the written exam.

Student evaluations in MOL300 are overall constructive and positive. Students say that, although the course was intensive and demanding, it was well worth their time and investment. Course satisfaction is further supported by statements from former MOL300 students who, upon completion of their MSc thesis work or in their professional work, say the course helped them much both in practical skills and in report/thesis writing. In addition, students who have completed MOL300 are also highly sought after as master student candidates in various research groups (mainly BIO and BioMed, but also Sars, Haukeland Hospital, IMR).

<On teaching lab and teaching staff>

The teaching lab facilities used by MOL300 are relatively well equipped. However, some instruments are old and worn out and thus require regular check-up or replacement. The issue of teaching staff (here mainly teaching assistants) demands full attention every semester. Since MOL300 is an advanced level lab course and many of the teachers are PhD candidates (i.e., time-limited appointees), it has become a big challenge to staff qualified and willing people. One of the measures to cope with the challenges is to pair new teaching assistants with old/experienced ones, and let these PhD teaching assistants teach the same subjects/topics during their 4-year appointment period.

<On student course evaluation>

About 50-60% of MOL300 students participated in the evaluation. The numbers in the period 2020 to 2024 were: 14/24 (58%, 2020), 12/16 (75%, 2021), 5/14 (36%, 2022), 9/15 (60%, 2023), 14/22 (64%, 2024). The following five main points were mentioned in the evaluations:

1. Consistency in the evaluation of reports

MOL300 tries to address the consistency issue by having teachers' meetings and making clearer guidelines. However, because the course has many teachers, it is a daunting task to have only one voice. (Here we are talking about minor, personal differences.) It is very understandable that students want only one way/rule to follow, without exceptions. But this 'one way and no exceptions' policy is not only possible, but also undesirable. For the former, unless we have only one teacher who evaluates all reports, this is not attainable. To ameliorate students' concerns and frustrations, the grading criteria have been straightened out and made clearer (and this is an ongoing work). Furthermore, the course-in-charge reviews the grading results of each report to see if there is an 'unusual' aspect. For the latter, each topic/project requires a (slightly) different emphasis on report format and content. This is evident in the existence of various scientific journals by discipline. MOL300 has a special session on report writing and each topic/project ends with a Q&A session on report writing of the relevant topic/project.

2. Lab protocols

In 2025 the lab protocols will be revised so that students can see more clearly the experimental procedures and the background information or explanation for these procedures.

3. New methodologies and topics

Fuelled by rapid developments in technology and instrumentation, methods and techniques in modern biochemistry and molecular biology are constantly changing. Although some 'old' methods are still in use, many have become obsolete just after a few years of use. Therefore, it is both exciting and challenging for experimentalists to stay up to date with new methods. MOL300 has two challenges. One is the lack of state-of-the-art equipment in the teaching lab. The other is that it takes a lot of effort to make a new lab protocol for a student course. Nonetheless MOL300 tries hard to 'be current'.

4. Textbook and required literatures

The syllabus for MOL300 consists of a textbook (Wilson and Walker: Principles and Techniques of Biochemistry and Molecular Biology, 8th Ed. 2018. Edited by A. Hofmann and S. Clokie) and other relevant materials, such as lab protocols. Because the information needed for the lab exercises in MOL300 is not fully covered by the textbook, detailed lab protocols and lectures are used. (The relevant book chapters and sections are clearly mentioned in the lab protocols.) Some specific topics are also covered in Q&A and/or symposium sessions. On the other hand, relatively a small portion of the textbook is directly used in the course.

5. Exam questions

Exam questions in MOL300 favour 'Why' over 'What'. One must think when answering 'Why', which in turn requires knowing 'What' first. Another emphasis is on the analysis and interpretation of experimental data. Students are often asked to justify their answers. If the defence (i.e., the logic) is good or strong, one gets considerable points even if the answer is factually wrong.

An example is a question about PCR-based conventional cloning. Here, one designs a primer pair for a fusion protein construct. (If the starting material is RNA, it should first be converted to DNA.) In order to answer the question, one should know what is required to make a fusion protein. The question is rather simple, but it requires much information. Because it is not easy to find a textbook that covers all the topics taught in MOL300 (see Point 4 above), exam questions are also based upon lab protocols, lectures, common Q&A sessions, and old exam questions. Each year, an old exam review is held about a week before the written exam date. (Students are expected to have worked on the old questions prior to the session.)