



**COURSE SCHEDULE 5MO113**  
**DEPARTMENT OF MOLECULAR BIOLOGY**  
**UPDATE 21.12.2020; EXPECTED STUDENTS CA 37**

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**Course dates:** February 18<sup>th</sup> to March 23<sup>th</sup>

**Exam:** XXXX 09.00-13.00: XXXX  
**Re Exam:** XXXX 09.00-13.00: XXXX

**Locations:** Lecture predominantly by zoom (links to be announced in Cambro)  
Other Lecture room: Thymine+Uracil (TU) building 6K  
Laboratory: Red lab (Building 6L)

**Course Literature:** See next page

**Course Administrator:** Ingela Nilsson, tel: 7852869  
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**Course Leader:** Victoria Shingler, tel. 785 2534  
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**Course Assistants:** David Cisneros (DC): david.cisneros@umu.se (DC)  
XXXXXX (XX): XXXX@umu.se (DC)

**Other Course Lecturers:**

Gemma Atkinson (GA)	Department of Molecular Biology
Matthew Francis (MF)	Department of Molecular Biology
Martin Gullberg (MG)	Department of Molecular Biology
Vasili Haurlyiuk (VH)	Department of Molecular Biology
Jörgen Johansson (JJ)	Department of Molecular Biology
Per Stenberg (PS)	Department of Ecology and Environmental Science

**Course components:** Lectures, laboratory exercises, discussion groups and problem solving classes.

**Mandatory components:** 1) Laboratory classes and their associated report (including the peer assessment/review session). 2) Discussion groups and associated scientific article written  
*Please note that laboratory reports and preparation of written working material for discussion groups have strict deadlines.*

**Absence** due to illness should be reported promptly to the course administrator.

## **Course Literature 5MO113:**

### 1] Genetics: From Genes to Genomes (5th International edition)

Leland H. Hartwell; Michael L. Goldberg; Janice A. Fischer; Leroy Hood; Charles F. Aquadro. Published by McGraw-Hill Education, U.S.A. (2014)  
ISBN 10: 0073525316 ISBN 13: 9780073525310

**Note:** 4<sup>th</sup> Edition free download at: <https://www.youtube.com/watch?v=8rKo5C4QCHY>

**Check out animations on:**

**[http://highered.mcgraw-hill.com/sites/007352526x/student\\_view0/](http://highered.mcgraw-hill.com/sites/007352526x/student_view0/)**

#### ***Most relevant Chapters for 5MO113***

Chapters 8: Gene Expression: the flow of information from DNA to RNA to protein

Chapters 10: Genomes and proteomes

Chapters 15: Gene regulation in prokaryotes

Chapters 16: Gene regulation in eukaryotes

2] Additional important information is provided in lectures (including laboratory introductions), together with lecture handouts, reviews and the original articles for discussion groups.

3] Other useful information is provided by on-line resources [see 5MO112]

## **Learning Goals (FSR's) 5MO113:**

- Apply knowledge about the fundamental processes of the cellular macromolecular machinery (RNA-polymerase and ribosomes) and to explain how the functioning of the cellular macromolecular machinery is analysed and evaluated with respect to gene expression in bacterial and eukaryotic cells.

- Understand and can describe how the functioning of the cellular macromolecular machinery is regulated (e.g. by proteins and regulatory RNAs) in response to signals such as binding of ligands and covalent modifications.

- Understand and can explain how the activity of gene products can be modulated at the post-transcriptional level (e.g. by Riboswitches, regulatory RNAs, post-translational modifications and export).

- Understand and describe how regulatory circuits can be used in gene expression system for biotechnological purposes.

- Be able to show knowledge and considerations in the design of gene-expression experiments and analyzing the resulting data.

- To show skill in both oral and written scientific communication in English

## Overview of lectures, labs, discussion groups and PSCs 5MO113

### Lectures:

1. Bacterial transcriptional regulation I (VS)
2. Bacterial transcriptional regulation II (VS)
3. External stimuli and gene regulation: Two-component systems (VS)
4. Signal sensing, regulatory logic, and synthetic regulatory devices (VS)
5. Transcriptional termination and attenuation (JJ)
6. Regulation of mRNA stability and function (JJ)
7. Bacterial translation and control of protein synthesis (GA)
8. Bacterial protein export systems (MF)
9. Global regulation and the “omics” (VS)
10. Protein expression systems: bacterial (VH or VS)
11. Eukaryotic transcriptional regulation (VS)
12. The eukaryotic ribosome and regulation of protein synthesis (GA)
13. Tool Box: for eukaryotic cells (MG)
14. Protein expression systems: eukaryotic (MG)
15. Transcriptomics and RNA sequencing (PS)

### Laboratory exercises

#### *Gene regulation wet lab with data interpretation*

Lab. 1 Reporter gene technology in gene regulation

#### *Protein expression wet lab with data interpretation*

Lab. 2 Protein expression analysis

Lab. 3 Dry Lab: Deletion analysis & Protein expression data interpretation lab

### Discussion groups and problem solving classes (PSCs)

Discussion groups and problem solving classes are designed to reinforce key concepts and to stimulate critical thinking that requires assimilation and interpretation of basic information given in the lectures.

Discussion group 1: Paradigms of bacterial transcriptional regulation (VS)

*(Dead-line for written material: 17.00 Feb 26<sup>th</sup>)*

Discussion group 2: Transcriptional reporter genes and biosensors (VS)

*(Dead-line for written material: 12.00 March 4<sup>th</sup>)*

Discussion group 3: Genetic switches in gene regulation (VS)

*(Dead-line for written material 17.00 March 9<sup>th</sup>)*

PSC1: data interpretation - Genetic data and gene regulation (VS)

PSC2: data interpretation - Bacterial regulatory circuitry (VS)

PSC3: data interpretation - Signalling circuitry (VS)

## Overview of laboratory component of the course

### Laboratory practical

#### *Gene regulation lab with data interpretation*

Lab. 1 Reporter gene technology in gene regulation

#### *Protein expression labs*

Lab. 2 Protein expression analysis

Lab. 3 Dry Lab: Deletion & Protein expression data interpretation lab

**Introduction to the dry lab.** The aim of the dry lab series incorporated into the practical part of this course is to introduce you (the student) to concepts and ways of thinking that are usually taught through a practical course in which you get your hands "wet".

The ability to manipulate and regulate genes and to express proteins is the corner stone of molecular biology techniques. There are few aspects of modern biology that have not been affected by the advent of molecular biology in some way, including areas that might not be expected to have a "molecular" component. In addition to being important in basic research, molecular biology has had far reaching effects in medical, pharmaceutical, and agricultural industries, in forensics, and in many other areas of applied science and technology. However, given the time-frame of the course, it is not possible for us to introduce you practically to all of the molecular biology techniques used in analysis of gene regulation and expression, or even to undertake all steps in a given analysis. Dry labs are designed using authentic data to complement your "wet labs", so that you can reach the more mentally stimulating part of any practical - the interpretation of genuine experimental results.

<b>Lab. 1:</b> Reporter gene technology in gene regulation (dry lab for 2021)	Day 1 Feb 18 <sup>th</sup> (Introduction) Day 2 Feb 19 <sup>st</sup> (data interpretation)
<b>Lab. 2:</b> Protein expression analysis wet lab (Feb 22 <sup>nd</sup> -26 <sup>th</sup> )	Day 1 put up overnight cultures Day 2 grow-up, induction, collection of pellets, and preparation of buffers for purification on day 3 Day 3 extracts, purification, gel running etc Day 4 additional time for gel imaging if needed Open office (DC March 9 <sup>th</sup> ) <i>for anyone who needs extra help.</i>
<b>Dry Lab. 3:</b> Deletion analysis & Protein expression data interpretation	To be done during Lab 2 incubation/waiting times and private study times Open office Dry Lab 3 (DC on March 5 <sup>th</sup> ) <i>for anyone who did not manage it or needs extra help.</i>

**Dead-line for dry Lab 3 papers to DC:**

**March 8<sup>th</sup> 17.00**

**Lab round-up:**

**March 2<sup>nd</sup>**

**Dead-line for Lab 1-2 written material for peer review:**

**March 15<sup>th</sup> 17.00**

**Dead-line for Lab 1-2 written material after peer review:**

**March 18<sup>th</sup> 17.00**

# Weekly Course Time Table

## Key deadline dates not to be missed ☺:

Discussion group 1: Paradigms of bacterial transcriptional regulation (VS)  
(*Dead-line for written material:* **17.00 Feb 26<sup>th</sup>**)

Discussion group 2: Transcriptional reporter genes and biosensors (VS)  
(*Dead-line for written material:* **12.00 March 4<sup>th</sup>**)

Discussion group 3: Genetic switches in gene regulation (VS)  
(*Dead-line for written material* **17.00 March 9<sup>th</sup>**)

Dry Lab 3 report: (*Dead-line for written material* **17.00 March 8<sup>th</sup>**)

Lab 1-2 report: (*Dead-line 1 for peer review:* **17.00 March 15<sup>th</sup>**)

Lab 1-2 report: (*Dead-line 2 for corrected versions based on peer review:*  
**17.00 March 18<sup>th</sup>**)

## WEEK 8 (WORKING WEEK 1 FEB 18<sup>TH</sup>-19<sup>TH</sup>)

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### Thursday Feb. 18<sup>th</sup>

### Lab 15.30 to ~16.30

- 09.00-09.45 Roll-Call & Introduction to the course (VS) Zoom  
10.00-12.00 **L1.** Bacterial transcriptional regulation I (VS) Zoom
- 13.00-13.30 Introductions to the laboratory course &  
Discussion group 1 literature assignment (VS) Zoom
- 13.45-~15.30 **Lab safety** - as in 5MO112 applies for 5MO113, reminder (DC) Zoom  
**Introduction to Lab. 1** & to keeping lab notes (DC) Zoom  
**Assignments into lab groups and Group A/B** (DC) Zoom
- 15.30-16.30 Red Lab available if anyone would like to try replica plating....

**OBS STUDENTS! Please alter DC if you do not have your own computer to bring on Friday 19<sup>th</sup> so that we can arrange one for you....**

### Friday Feb. 19<sup>th</sup>

### Lab1 all day 08.00 to ~17.00 (bring your computer)

*Thymine/Uracil booked (max 29 students hence two groups),  
Computers booked with Marek, but he needs to know how many...*

- 08.00-11.00 **Lab. 1: Group A** (DC) be sure to **check your answers to the specific questions and your plots of the data with the course assistants before you leave.** It is important that you have this clear.
- 12.00-14.00 **L2.** Bacterial transcriptional regulation II (VS) (Zoom)
- 14.00-17.00 **Lab. 1: Group B** (DC) be sure to **check your answers to the specific questions and your plots of the data with the course assistants before you leave.** It is important that you have this clear.

**WEEK 9 (WORKING WEEK 2 FEB 22<sup>ND</sup> -26<sup>TH</sup>)**

*Use unscheduled time for private study, e.g. Discussion group 1*

**Monday Feb. 22<sup>nd</sup>** (Red Lab booked 12.00 to ~17.00)

*(Thymine + Uracil, max 29 students, also booked 12.00-17.00)*

*(Students, bring your computer if you would like to e-documentation of your planning)*

09.00-11.00 L3. External stimuli and gene regulation: Two-component systems (VS) Zoom

12.00~13.00 **Introduction to Lab 2 and dry Lab 3:** (DC)

13.00-17.00 Planning of your work flow for Lab 2.

**OBS! Students: Please get your plan approved before starting your experiments or leaving for private study!**

**Lab 2 start for some groups**

**Tuesday Feb. 23<sup>rd</sup>** (Red Lab booked 08.00 to ~17.00)

*(Thymine + Uracil, max 29 students, also booked 12.00-17.00)*

*(Students, bring your computer if you need one)*

09.00-11.00 L4. Signal sensing, regulatory logic, and synthetic regulatory devices (VS)

Zoom

12.00~17.00 **Lab. 2 start / continued (group dependent) & dry Lab 3**

**Wednesday Feb 24<sup>th</sup>** (Red Lab booked 08.00 to ~17.00)

*(Thymine + Uracil, max 29 students, also booked 08.00-17.00)*

*(Students, bring your computer if you need one)*

**Lab. 2 & dry Lab 3 continued (group dependent)**

And private study for Discussion group 1

**Thursday Feb 25<sup>th</sup>** (Red Lab booked 08.00 to ~17.00)

*(Thymine + Uracil, max 29 students, also booked 08.00-12.30)*

*(Students, bring your computer if you need one)*

**Lab. 2 & dry Lab 3 continued (group dependent)**

And private study for Discussion group 1

**Friday Feb 26<sup>th</sup>** (Red Lab booked 08.00 to 12.00)

**Note that 5MO120 will be using the lab from 12.30**

*(Thymine + Uracil, max 29 students, also booked 08.00-12.00 and 12.30-17.00)*

*(Students, bring your computer if you need one)*

08.00-12.00 **& dry Lab 3 continued (group dependent)**

and private study for Discussion group 1

12.00 *Uniaden*

**17.00 *Dead-line for Discussion group 1 written material***

## WEEK 10 (WORKING WEEK 3 MARCH 1<sup>ST</sup> –5<sup>TH</sup>)

*Use unscheduled time for private study, e.g. Discussion groups/Lab Reports etc*

### Monday March 1<sup>st</sup>

- 09.00-11.00 Private study for e.g. Discussion group 1 literature assignment  
12.00-16.00 **Discussion group 1** (VS) and Discussion group 2 assignment (VS) Zoom  
Private study (e.g. Discussion group 2 literature assignment)

### Tuesday March 2<sup>nd</sup>

- 09.00-10.00 **Lab round-up** (VS) Zoom  
10.15-11.15 **How to write up your Lab material** (DC) Zoom  
12.00-14.00 **L5.** Transcriptional termination and attenuation (JJ) Zoom  
(OK e-mail 7<sup>th</sup> Dec)  
14.00- Private study (Discussion group 2 literature assignment)

### Wednesday March 3<sup>rd</sup>

- 09.00-11.00 **L8.** Bacterial protein export systems (MF) Zoom  
(OK e-mail 9<sup>th</sup> Dec)  
12.00-14.00 **L6.** Regulation of mRNA stability and function (JJ) Zoom  
(OK e-mail 7<sup>th</sup> Dec)  
14.00- Private study (e.g. Discussion group 2 literature assignment)

### Thursday March 4<sup>th</sup>

- 09.00-11.00 **L9.** Global regulation and the “omics” (VS) Zoom  
**12.00** ***Dead-line for Discussion group 2 written material***

### Friday March 5<sup>th</sup>

- 09.00-11.00 **Open office for Dry Labs 3:** Protein expression data interpretation lab (DC)  
*for anyone who did not manage it during Lab.2 incubations and waiting times,  
or needs some extra help.* (Thymine/Uracil booked; max 29)  
12.00-14.00 **L7** Bacterial translation and control of protein synthesis (GA) Zoom  
(OK by e-mail 07.12.2020)  
14.00-16.00 **Discussion group 2** (VS) and Discussion group 3 assignment (VS) Zoom  
Private study



## WEEK 11 (WORKING WEEK MARCH 8<sup>TH</sup>-12<sup>TH</sup>)

*Use unscheduled time for private study, e.g. Discussion groups/Lab Reports etc*

### Monday March 8<sup>th</sup>

- 09.00-11.00 Open lecture space / Private study  
12.00-14.00 **L10.** Protein expression systems: bacterial (VH) Zoom  
(OK by e-mail 07/12)  
14.00- Private study e.g. for DG3 and lab reports  
**17.00** ***Dead-line for Dry Lab 3 written material (to DC)***

### Tuesday March 9<sup>th</sup>

- 09.00-11.00 **L11.** Eukaryotic transcriptional regulation (VS) Zoom  
12.00-13.00 **Open office for Labs 1 & 2** (DC) *for anyone who needs extra help*  
(Thymine/Uracil booked; max 29)  
13.00- Private study e.g. for DG3 and lab reports  
**17.00** ***Dead-line for Discussion group 3 written material (to VS)***

### Wednesday March 10<sup>th</sup>

- 09.00-11.00 **L12.** The eukaryotic ribosome and regulation of protein synthesis (GA) Zoom  
(OK by e-mail 07.12.2020)  
12.00- Private study for Lab reports etc

### Thursday March 11<sup>th</sup>

- 09.00-11.00 **L15.** Transcriptomics and RNA sequencing (PS) Zoom  
(OK by e-mail 13.12.2020)  
12.00-16.30 **Discussion group 3** and problem solving class 3 (VS) Zoom

### Friday March 12<sup>th</sup>

- 09:00-11.30 **L13.** Tool Box: for eukaryotic cells (MG) Zoom  
**(still awaiting response)**

Thereafter, Private study for Lab report etc

## WEEK 12 (WORKING WEEK 5 MARCH 15<sup>TH</sup>-19<sup>TH</sup>)

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Use unscheduled time for private study, e.g. Lab Reports etc

### Monday March 15<sup>th</sup>

09.00-11.30 L14. Protein expression systems: eukaryotic (MG) Zoom  
(still awaiting response)

Private study e.g. Lab report 1-2 / Exam

**17.00** *Dead-line for Lab 1&2 written material  
(to be given/sent to your designated peer reviewers: e.g.*

*Group 1 ↔ Group 2;      Group 3 ↔ Group 4      Group 5 ↔ Group 6;  
Group 7 ↔ Group 8;      Group 9 ↔ Group 10;      Group 11 ↔ Group 12  
Group 13 ↔ Group 14;      Group 15 ↔ Group 16 etc*

**NOTE:** you will need a signed assessment form from your Peer assessors to be able to submit your final written material!

### Tuesday March 16<sup>th</sup>

09.00-11.30 LX. Back up lecture time slot by Zoom /Private study  
11.30- Private study & performing peer review

### Wednesday March 17<sup>th</sup>

09.00-11.30 LX. Back up lecture time slot by Zoom / Private study  
12.00-17.00 **Lab 1&2 written material: Peer Assessment Discussion & correction** (DC)  
**NOTE:** here is where you should provide your written assessment of others and discuss you mutual assessments of each other's written material. You will need a signed assessment form(s) from your Peers to be able to submit your lab report material!

### Thursday March 18<sup>th</sup>

09.00-17.00 Lab 1-2 report correction (thereafter Private study time)  
**17.00** **Dead-line Lab 1-2 written material: resubmission after Peer Assessment & corrections to DC. Remember, to send these ALONG WITH SIGNED PEER REVIEW FORM(S)** (submit to assistants at .umu@analys.urkund.se)

### Friday March 19<sup>th</sup>

09.00-12.00 Private study:  
12.00-15.00 **Course Q and A session** (VS and others Zoom) / course evaluation  
(Thymine/Uracil booked; max 29)  
15.00- Private study

## WEEK 13 (WORKING WEEK 6 MARCH 22<sup>ND</sup>-23<sup>RD</sup>)

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### Monday March 22<sup>nd</sup>

Private study:

### Tuesday March 23<sup>rd</sup>

**Exam:** XXXX  
**Re Exam:** XXXX