

Schedule for Molecular Genetics, 15 credits, 2021.

Course dates: January 18– March 23, 2021
Location: Zoom lectures if lecture hall is not indicated
 Thymine and Uracil
 Laboratory: Red (R) laboratory floor 1

Course literature: All important information is covered by the lectures (including lab introductions) together with reviews and the original articles for discussion groups. In addition to more traditional lecture, the “Molecular Genetics in Action Lectures” (MGA)-tagged lectures are specifically designed to emphasize how molecular genetics has been used to solve biological problems. Basic knowledge in molecular genetics is a prerequisite for this course. We do not demand a specific text book for this course, but recommend Clark, D. P., (2012) “Molecular Biology” 2nd edition, Hartwell, L.H et al. (2015): "Genetics, from genes to genomes", 5th edition used on the previous course or an equivalent text book would also provide support for this course. For further reading in bacterial genetics: Trun and Trempy (2004) “Fundamental Bacterial Genetics” - Blackwell Publishing - is recommended.

Mandatory requirements of the course:

Laboratory classes & reports, problem solving classes/discussion (PSC) and scientific articles assignments are mandatory. Absence from mandatory exercises due to illness should immediately be reported to the course secretary.

Labs

Experiment 1: "Isolation and mapping of a suppressor mutation in *E. coli*."
Experiment 2: "Inactivation of an *E. coli* gene for functional studies"
Experiment 3: "Genetic analysis of yeast tRNA mutations"
Experiment 4: "Protein-protein interactions - the 2-hybrid system"
Exercise 1: "Computer exercise: Analysis of DNA and protein sequences"
Exercise 2: "Computer exercise: Deletion of the *nusA* gene in *E. coli*"
Exercise 3: "Meiotic mapping of the *IMT1* gene of *Saccharomyces cerevisiae*"

Course leader: Changchun Chen Tel: 786 71 35, E-mail: changchun.chen@umu.se

Lecturers:

Johan Henriksson (JH)	Anders Byström (AB)	Changchun Chen (CC)
Matthew Francis (MF)	Jörgen Johansson (JJ)	Björn Schröder (BS)
Jan Larsson (JL)	Vicky Shingler (VS)	Per Stenberg (PS)
Jeanette Tångrot (JT)	Jonas von Hofsten (JvH)	Silvia Remeseiro (SR)
Jonathan Gilthorpe (JG)	Max Hahn (MH)	Simon Tuck (ST)

Assistents:

Yngve Östberg (YÖ, yngve.ostberg@umu.se)

Course secretary:

Ingela Nilsson (5MO120/ 3MB031), Tel:7852869 Ingela.Nilsson@umu.se

Exam: Tuesday March 23, 9.00-13.00 (Östra Paviljongen)

Re-exam: Saturday May 22, 9.00-13.00 (Östra Paviljongen)

Important dead-lines for mandatory problem solving classes (PSCs), Literature assignments and practical's:

FRI 22/1	17.00	Answers to PSC 2 for discussion TUE 26/1
MON 25/1	17.00	Answers to PSC 3 & 4 for discussion MON 1/2
FRI 5/2	17.00	Report on strategy for experiment 2
TUE 9/2	18.00	Experiment 1 Task 6 for discussion THU 11/2
FRI 12/2	18.00	Answers to PSC 6 for discussion MON 15/2
FRI 12/2	18.00	Answers to PSC 7 for discussion Tue 23/2
MON 15/2	18.00	Answers to Experiment 3
WED 17/2	18.00	Answers to Experiment 4
TUE 23/2		Remember to read and try to do genetic problems I for THU 25/2
TUE 2/3	17.00	Article1 written assignment for assessment MON 8/3
WED 3/3	17.00	Read and try to do genetic problems II for FRI 5/3
FRI 5/3	18.00	Report on Experiment 2
TUE 9/3	17.00	Article 2 written assignment for discussion THU 11/3

WEEK 3

MON 18/1

- 09.00 Introduction to the course (CC).
- 09.30 Lecture: Genetic nomenclature, mutations and their isolation and selection (VS).
- 12.00 Lunch
- 14.00 Problem solving class 1 (PSC 1) (YÖ, CC) (**Location: Thymine and Uracil**)

TUE 19/1

- 09.00 Lecture: "The concept of suppression" (AB) (PSC2: questions only)
- 11.00 Lunch
- 12.00 Lecture: Prokaryotic gene structure and regulation: the use of transcription versus translational fusions (VS) and PSC 3 (questions only).
- 14.00

WED 20/1

- 09.00 Lecture: From restriction enzymes to simple cloning (VS) and PSC 4 (questions only).
- 11.00 Lunch
- 12.00 Lecture: Introduction to bioinformatics (PS).

THU 21/1

- 09.00 Lecture (MGA): Genetic analysis of a transcriptional regulator (VS). With introduction to Experiment 1: Isolation and mapping of a suppressor mutation in *E. coli* (VS)
Pre-lab Experiment 1 - Tasks 1 and 2 (VS, YÖ)
- 12.00 Lunch
- 13.00 Computer Exercise 1: "Analysis of DNA and protein sequences using computer programs". (**Location: Thymine and Uracil**)

FRI 22/1

- 09.00 Lab Safari (To familiarize the students with the lab lay out, where everything is, lab etiquette, the use of equipment you will be using in the labs) and Experiment 1 - Task 3 (YÖ) (**Location: Thymine and Uracil**)
- 10.00 Lab Safari and Experiment 1 - Task 3 continued (**Location: Red Lab**)
- 11.00
- 17.00 **Deadline answers to PSC 2 (to AB)**

WEEK 4

MON 25/1

- 09.00 Lecture: Classical mutation mapping in bacteria-phage transduction and HFR (VS)
- 11.00 PSC 5 (VS, YÖ).
- 12.00 Lunch
- 13.00 Pre-lab Experiment 1 - Task 3 (YÖ) (**Location: Red Lab**)
- 16.00
- 17.00 **Deadline answers to PSC 3 and PSC 4 (to VS)**

TUE 26/1

- 09.00 Pre-lab Experiment 1 - Task4 (VS, YÖ)
- 12.00 Lunch
- 13.00 PSC 2 discussion (AB)

WED 27/1

- 09.00 Lecture: Allelic replacement in bacteria and site directed mutagenesis using PCR with introduction to computer exercise 2 (MF).
- 11.00 Lunch
- 12.00 Computer exercise 2: Deletion of the *nusA* gene in *E. coli* (**Location: Thymine and Uracil**)

THU 28/1

- 09.00 Pre-lab. Experiment 1 – Task 5. (VS, YÖ)
- 11.00 Lunch
- 12.00 Lecture: Scientific Literacy and the Scientific Method and Scientific article 1
- 14.00 assignment (VS).

FRI 29/1

- 09.00 Pre-lab. Experiment 1 – Task 5 and Task 6 (VS, YÖ).

WEEK 5

MON 1/2

- 09.00 PSC3 and PSC4 discussion (VS).
- 13.00 Lecture (MGA): “Regulation of metabolism in the nematode *C. elegans*” (ST)

TUE 2/2

- 09.00 Introduction to experiment 2. “Inactivation of an *E. coli* gene for functional studies”, planning/ discussions in groups. (YÖ)
- 12.00 Lunch
- 13.00 Continue discussion of experiment 2 in groups at a place of your preference

WED 3/2

- 09.30 Discussion of strategy for Experiment 2. (YÖ) (**Location: Thymine and Uracil**)
- 13.30 Groups 1 and 3 (09.30-10.00)
- Groups 2 and 4 (10.00-10.30)
- Groups 5 and 7 (10.30-11.00)
- Groups 6 and 8 (12.00-12.30)
- Groups 9 and 11 (12.30-13.00)
- Groups 10 and 12 (13.00-13.30)

THU 4/2

- 09.00 Lecture: Yeast Genetics I, Linkage and complementation analysis in yeast. (CC)
Exercise 3: “Meiotic mapping of the *IMT1* gene of *Saccharomyces cerevisiae* and PSC 6 (questions only) (CC)
- 12.00 Lunch
- 13.00 Lecture: The CRISPR-Cas9 genome engineering system (CC).

FRI 5/2

- 10.00 Lecture: RNAi (CC).
- 17.00 **Deadline, Report on strategy for experiment 2**

WEEK 6

MON 8/2

- 09.30 Lecture: “Optogenetics” (CC)
- 13.00 Lecture: “The art of genetic screens” (CC).

TUE 9/2

- 11.00 Lecture: Yeast Genetics II; Vectors in yeast and allelic exchange (CC).
- 12.00 Pre-lab. Experiments 2. (YÖ) (**Location: Red Lab**)
- 17.00
- 18.00 **Deadline for Experiment 1 – Task 6 written reports (to YÖ)**

WED 10/2

- 08.00 Experiment 2 (YÖ) (**Location: Red Lab**)
- 09.00 Lecture: Yeast Genetics III; Libraries and manipulation of yeast. Scientific article 2 assignment (CC).
- 10.00 Experiment 2 (YÖ) (**Location: Red Lab**)
- 11.00 Lunch
- 12.00 - Experiment 2 (YÖ) (**Location: Red Lab**)
- 17.00

THU 11/2

- 09.00 Lecture: “Small RNAs”. Discovery of a new regulatory entity and PSC 7 (questions only) (JJ).
- 11.00 Lunch
- 12.00 Discussion/ roundup Experiment 1 (VS).
- 14.00 - Experiment 2 (YÖ) (**Location: Red Lab**)
- 17.00

FRI 12/2

- 09.00 Lecture: “RNA-sequencing: Constructing and interpreting libraries” (JH)
- 11.00 Lunch
- 12.00 Experiment 2 (YÖ) (**Location: Red Lab**)
- 17.00
- 18.00 **Deadline answers PSC 6 and PSC 7**

WEEK 7

MON 15/2

- 08.00 Experiment 2 (YÖ) (**Location: Red Lab**)
- 09.00 Lecture (MGA), "The wobble hypothesis revisited" (AB).
- 10.00 Discussion PSC 6 (CC) (**Location: Thymine and Uracil**)
- 11.00 Lunch
- 12.00 Experiment 2. (YÖ) (**Location: Red Lab**)
- 17.00
- 18.00 **Deadline answers to Experiment 3.**

TUE 16/2

Student Sports Day (Hälsa på campus)

WED 17/2

- 09.00 Lecture: Protein-protein interactions-protein based approaches (MF).
- 11.00 Lunch
- 12.00 Pre-lab Experiment 3; Genetic analysis of tRNA mutations. (**Location: Thymine and Uracil**).
- 17.00 Thereafter, experiments 2 and 3.
- 18.00 **Deadline answers Experiment 4.**

THU 18/2

- 09.00 Pre-lab. Experiment 4; Protein-protein interactions-the 2-hybrid system (YÖ) (**Location: Thymine and Uracil**)
- 11.00 Lunch
- 12.00 Pre-lab. Experiments 2, 3 and 4.

FRI 19/2

- 09.00 Pre-lab. Experiments 2 and 4. (YÖ) (**Location: Red lab**).
- 10.00 Experiments 2, 3 and 4 (**Location: Red lab**).
- 17.00

WEEK 8

MON 22/2

- 09.00 Experiments 2, 3 and 4 (YÖ) (**Location: Red Lab**)
- 11.00 Lunch
- 12.00 Lecture (MGA): “Fish for science; the zebrafish model system” (JvH).

TUE 23/2

- 09.00 Discussion PSC 7 (JJ).
- 10.00 Lecture (MGA): “The yeast Elongator complex”-genetic identification of a principle function. (AB).
- 12.30 Lecture (MGA): “Oxygen mediated behavioral responses in *C. elegans*” (CC)
- 17.00 **Remember to read and try to do genetic problems I. Discussion on 25/2.**

WED 24/2

- 09.00 Lecture (MGA): “Modelling disease mechanisms in neurodegeneration using patient-derived stem cells” (JG).

THU 25/2

- 10.00 Lecture: “3D Fluorescence Imaging Systems and Tissue Clearing” (MH)
- 12.30 Genetic problems I (VS, YÖ).
- 16.30 Genetic problems II (questions only)

FRI 26/2

- 09.00 Lecture: Next generation sequencing (JT)
- 11.00 Lunch
- 14.00 Pre-labs 2, 3 and 4 (**Location: Thymine and Uracil**)
Thereafter experiments 2, 3 and 4.

WEEK 9

MON 1/3

- 09:00 Lecture: “Chromosome-wide gene regulation and epigenetics” (JL).
12.00 Lecture: “Analyzing NGS data with R and Linux” (JH)

TUE 2/3

- 09.00 Lecture: (MGA): “The human gut microbiota” (BS)
12.00 Lecture: “Real time PCR and digital PCR“ (SR)
18.00 **Deadline for scientific article 1 written assignment.**

WED 3/3

- 09.00 Lecture: “High throughput genetic screening: from behavior to molecular mechanisms”. (JH)
12.15 Lecture: “Approaches to study 3D genome organization” (SR).
17.00 **Read and try to do genetic problems II for FRI 5/3**

THU 4/3

- 09.00 Lecture (MGA): “Long-range gene regulation and 3D chromatin organization: From development to cancer” (SR).
13.00 Lecture (MGA): “3D Imaging applied to the Pancreas – Overview to single cell resolution” (MH)

FRI 5/3

- 09.00 Lecture: “Single-cell methods with Python, and the future of molecular biology” (JH).
12.00 Genetic problems II (CC) (**Location: Thymine and Uracil**)
18.00 **Deadline for the report of Exp. 2 (to YÖ)**

WEEK 10

MON 8/3

09.00 Scientific article 1 - assessments (CC) – **Completion Dead-line 14.00. (Location: Thymine and Uracil)**

14.00

14.30 Experiment 3 and 4 (YÖ) **(Location: Red Lab)**

17.00

TUE 9/3

10.00 Lecture: “Mitochondrial genetics” (CC)

12.00 Experiment 4, **Lab cleaning afterwards! (YÖ) (Location: Red Lab)**

15.00

17.00 **Deadline scientific article 2 written assignment.**

WED 10/3

Individual studies

THU 11/3

09.00 Scientific article 2 (Groups 1-5), (CC) **(Location: Thymine and Uracil)**

10.00 Scientific article 2 (Groups 6-10), (CC) **(Location: Thymine and Uracil)**

In parallel, groups not discussing scientific article 2 will do Course evaluation.

FRI 12/3

Individual studies

WEEK 11

MON 15/3

Individual studies

TUE 16/3

12.00 Summary Experiments 3 and 4 (YÖ).
13.00

WED 17/3

Individual studies

THU 18/3

09.30 Questions and discussions before the exam (VS, CC) (**Location: Thymine and Uracil**)
12.30

FRI 19/3

Individual studies

TUE 23/3

09.00 EXAM, (**Location: Östra Paviljongen**)
13.00