



COURSE SCHEDULE

5MO112 Genetics and Genetic Techniques 7.5 ECTS

- Course dates:** January 18, 2020 to February 17, 2021
- Exam:** February 17, 2021, 09.00-13.00, Place: Östra Paviljongen
- Re Exam:** April 17, 2021, 09.00-13.00, Place: Östra Paviljongen
- Localities:** Lecture room: Zoom meetings – meeting links are found on the Canvas course page
- Laboratory: Red and Green laboratories, Building 6L, Floor 1

Course Literature: see next page

Course leader: Debra Milton debra.l.milton@umu.se

Course administrator: Ingela Nilsson ingela.nilsson@umu.se

Course Assistant: Jyoti Gurung jyoti.mohan.gurung@umu.se

Other course lecturers:

Debra Milton	(DM)	Department of Molecular Biology
Jan Larsson	(JL)	Department of Molecular Biology
Gemma Atkinson	(GA)	Department of Molecular Biology
Barbara Sixt	(BS)	Department of Molecular Biology
Johannes Hanson	(JH)	Umeå Plant Science Centre (Plant Physiology)
Monica Holmberg	(MH)	Department of Medical Biosciences
Anna Rosén	(AR)	Epidemiology and Global Health
Kalle Grill	(KG)	Philosophy

Course components: Lectures, laboratory exercises, problem-solving classes, and an ethics and genetics workshop

Mandatory components: Laboratory classes, associated assignments, and the ethics and genetics workshop

Attendance at lectures and problem-solving classes is highly recommended.

Absence from mandatory exercises due to illness should immediately be reported to the course administrator.

COURSE LITERATURE AND OTHER RESOURCES

Genetics is a constantly developing field and resources for this course provide up-to-date supplementary information for during lectures, laboratory exercises and problem-solving classes. Textbooks are great support but do not substitute for lectures and other exercises.

1) Main textbook

"Genetics: from genes to genomes" (5th and 6th edition)

LeLand Hartwell, Michael Goldberg, Janice Fischer, Leroy Hood, and Charles (Chip) Aquadro McGraw Hill, ISBN10: 0073525316, ISBN13: 9780073525310 (2014)

Electronic 4th edition of this book can be downloaded from the Canvas course site

This book partially supports this course and is recommended for both this course (5MO112) and the course that immediately follows (5MO113)

Most relevant Chapters

Chapters 1:	Genetics: the study of biological information
Chapters 2:	Mendel's principles of heredity
Chapters 3:	Extensions to Mendel's laws
Chapters 4:	The chromosome theory of inheritance
Chapters 5:	Linkage, recombination and the mapping of genes on chromosomes
Chapters 6:	DNA structure, replication, and recombination
Chapters 7:	Anatomy and function of a gene: dissection through mutation
Chapters 8:	Gene Expression: the flow of information from DNA to RNA to protein
Chapters 9:	Digital analysis of DNA
Chapter 14:	Prokaryotic and organelle genetics

2) Other resources that may be useful are also found on the Canvas course site or downloaded for free

From Genes to Genomes Concepts and Applications of DNA Technology
Jeremy W Dale and Malcolm von Schantz

Electronic edition of this book can be downloaded free at the following site or from the Canvas course page

<https://epdf.pub/from-genes-to-genomes-concepts-and-applications-of-dna-technology>

A free textbook on Microbiology from openstax can be downloaded free at the following site or from the Canvas course page

<https://openstax.org/details/books/microbiology#resources>

Other free downloads of textbooks can be found at epdf.pub

3) Additional information is provided in lectures and laboratory introductions

4) **The following videos must be viewed before attending respective lecture and/or problem-solving class (PSC).** You can copy this link or watch them from the Canvas course site.

Primer design video

https://www.youtube.com/watch?v=c-f1H07D_70

Restriction enzyme mapping 1 and 2 (PSC2)

https://www.youtube.com/watch?v=yR_heZ4n4Gc

<https://www.youtube.com/watch?v=MeTWD8ECeiQ>

5) Genetic glossary and tutorial

<http://www.genetics.edu.au/Publications-and-Resources/glossary-1>

LECTURE TOPICS

General and Bacterial Genetic Analysis

1. What is genetics and central dogma overview
2. The key tools of the geneticist: mutations, selections and screens
3. Mutation occurrence and DNA repair
4. Recombination and gene transfer in bacteria
5. DNA cloning and genetic analysis in bacteria

Molecular Genetic Techniques common to Genetic Dissections in All Organisms (MGT)

1. *MGT*: Gene and operon fusions
2. *MGT*: Polymerase Chain Reaction-PCR
3. *MGT*: DNA sequencing and DNA-protein interactions techniques
4. *MGT*: Detecting DNA, RNA and proteins
5. *MGT* Introduction to bioinformatics methods for sequence analysis
6. *MGT*: CRISPR-Cas9 genome editing

Genetic Analysis in Diploid Organisms

1. Mendelian Genetics and the principles of inheritance
2. Linkage, recombination and gene mapping
3. Genomes and species
4. Locating disease associated alleles
5. Plant biotechnology and transgenic plants
6. *Arabidopsis* as a model genetic organism

Bioethics

1. Ethics and Genetics Workshop

LAB EXERCISES

Lab. 1: The Ames test for mutagen identification

Lab. 2: Creating a gene fusion library using a transposon

Lab. 3: Allelic replacement to create an in-frame deletion of a metalloprotease gene

PROBLEM SOLVING CLASSES (PSCs)

These class periods are used to reinforce key concepts and to stimulate critical thinking.
YouTube videos must be viewed before attending the respective PSC.

PSC 1: Codons, reading frames and mutations

PSC 2: Restriction enzymes, cloning and complementation

PSC 3: Gene fusions and reporters

PSC 4: Primer design

PSC 5: Northern, Southern and Western

PSC 6: How to use Mendelian genetics

PSC 7: Blast interpretations (in conjunction with Labs 1 and 3)

LEARNING GOALS for 5MO112

- To describe how genetic material is inherited, mapped, analysed and identified in bacteria and eukaryotes.
- To describe how genetic material can mutate and the effects of these mutations.
- To describe how the external environment can affect the genetic material
- To describe how the genetic material can be utilized in bio-technique development
- To demonstrate practical skill in execution, interpretation and statistical processing of data from genetic and gene technology experiments
- To demonstrate proficiency in both oral and written scientific communication in English

Weekly Schedule

Use unscheduled time for private study to answer lab report questions and to read the recommended literature

Week 1: January 18 – 22, 2021

Monday 18th January

09:00-09:30	Zoom	Roll call and overview of the course (DM)
09:30-11:30	Zoom	L1 What is genetics and an overview of the central dogma (DM)
Lunch		
13:00-15:00	Zoom	L2 The key tools of the geneticist: mutations, selections and screens (DM)

Tuesday 19th January

09:00-11:00	Zoom	L3 Mutation occurrence and DNA repair (DM)
11:00-12:30	Zoom	PSC 1: Codons, reading frames and mutations (DM)
Lunch		
14:00-15:00	Zoom	Lab Safety Lab 1 Introduction for Ames test lab (DM, JG)

Wednesday 20th January

09:00-12:00	red and green labs	Lab safety Lab 1 (day 2) CFU determination and Ames test (DM, JG)
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Thursday 21st January

09:00-11:00	Zoom	L4 Recombination and gene transfer in bacteria (DM)
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Friday 22nd January

09:00-11:00	Zoom	L5 DNA cloning and genetic analysis in bacteria (DM)
11:00-12:30	Zoom	PSC 2: Restriction enzymes, cloning and complementation (DM)
Lunch		
14:00-16:00	red and green labs	Lab 1 (day 3) Determination of CFU and revertant frequency (DM, JG)

Week 2: January 25 – 29, 2021

Monday 25th January

09:00-11:00 Zoom **L6 MGT:** Gene and operon fusions (DM)

11:00-12:30 Zoom **PSC 3** Gene fusions and reporters (DM)

Lunch

14:00-15:00 Zoom **Lab 2** Transposon mutagenesis introduction (DM, JG)

Tuesday 26th January

09:00-11:30 red and green labs **Lab 2 (day 2)** Transposon mutagenesis - conjugation set up (DM, JG)

Uniaden 2021 – no scheduled events in the afternoon

Wednesday 27th January

09:00-11:00 red and green labs **Lab 2 (day 3)** Transposon mutagenesis: selection for gene fusion mutations (DM, JG)

Lunch

13:00-15:00 Zoom **L7 MGT:** Polymerase Chain Reaction-PCR (BS)

15:00-16:30 Zoom **PSC 4:** Primer design (DM)

Thursday 28th January

09:00-11:00 Zoom **L8 MGT:** DNA sequencing and nucleic acid-protein interactions techniques (DM)

Friday 29th January

09:00-11:00 Zoom **L9 MGT:** Detecting DNA, RNA and proteins (DM)

11:00-12:30 Zoom **PSC 5** Northern, Southern and Western techniques (DM)

Lunch

14:00-16:00 Zoom **Lab 3 – Introduction:** Allelic replacement to create an in-frame mutation (DM, JG)

Q and A session (DM)

This is your chance to get help with study questions

Be sure to come prepared with questions on aspects that you are uncertain about

Week 3: February 1 – 5, 2021

Monday 1st February

09:00-11:00	Zoom	L10 Introduction to basic bioinformatics methods for DNA sequence analysis (GA) <i>This includes computer demonstrations that you can follow on your own computer</i>
Lunch		
13:00-15:00	Zoom	Lab 3 (day 1-theoretical lab) overlap PCR and allelic exchange (DM, JG)

Tuesday 2nd February

09:00-11:00	Zoom	L11 MGT: CRISPR-Cas9 genome editing (BS)
Lunch		
13:00-16:00	red and green labs	Lab 2 (day 4) Transposon mutant analysis Lab 3 (day 2) colony PCR screening and phenotypic analysis (DM, JG)

Wednesday 3rd February

09:00-11:00	Zoom	L12 Mendelian Genetics and the principles of inheritance (JL)
Lunch		
13:00-15:00	Zoom	L13 Linkage, recombination and gene mapping (JL)

Thursday 4th February

09:00-12:00	Zoom	L14 Genomes and species (JL) PSC 6: How to use Mendelian genetics (JL)
Lunch		
14:00-16:00	red and green labs	Lab 3 (day 3) agarose gel analysis of PCR products and phenotypic analysis (DM, JG) <i>Lab cleaning</i>

Friday 5th February

09:00-11:00	Zoom	L15 Locating disease associated alleles (MH)
Lunch		
12:30-14:30	Zoom	PSC 7: Blast interpretations (DM) Lab 1 (day 4) Blast analysis of sequence data and correlations of genetic reversions with phenotypes (DM, JG) Lab 3 (day 4) confirmation analysis of the DNA sequence containing in-frame mutation (DM, JG)

Week 4: February 8 – 12, 2021

Monday 8th February

09:00-12:00 Betula lecture hall Ethics and Genetics Workshop (AR, KG)

Tuesday 9th February

09:00-11:00 Zoom **L16** Plant biotechnology and transgenic plants (JH)

Wednesday 10th February

09:00-11:00 Zoom **L17** Genetic Model Organisms - *Arabidopsis* (JH)

Thursday 11th February

09:00-10:30 Zoom Q and A session (DM/JL)
This is your chance to get help with study questions
Be sure to come prepared with questions on aspects that you are uncertain about

Friday 12th February

09:00-10:30 Zoom Q and A session (DM/JL)
This is your chance to get help with study questions
Be sure to come prepared with questions on aspects that you are uncertain about

Week 5: February 15 – 17, 2021

Monday 15th February

17:00

Deadline for completed Laboratory Questions to be submitted electronically to the teaching assistants using the 'Urkund' client email addresses:

Submit to: *debra.milton.umu@analys.orkund.se*

Exam: Wednesday February 17, 2021

Place: Östra Paviljongen

Time: 09:00-13:00

Room number to be announced closer to the exam time

Note time for re-exam

RE-exam: Saturday April 17, 2021

Time: 09:00-13:00

Place: Östra Paviljongen

Room number to be announced closer to the exam time.