Course directory 2014.2015

# school of Biology (FBM-BIO)
# Master

* your selection

> Biology > Master of Science in Behaviour, Evolution and Conservation

# SUMMARY

## NOTICE

This course catalogue was produced using data from the *SylviaAcad* information system of the University of Lausanne. Its database contains all information about courses proposed by the different faculties and their times. This data can also be consulted online at the address :
**https://applicationspub.unil.ch/interpub/noauth/php/Ud/index.php**.

Web site of the faculty : **http://www.unil.ch/ecoledebiologie/**

Generated on : 03.03.2016

# LEGEND

## NAME OF THE COURSE

Teacher

| Type of course | Status | Hours per week | Teaching language | Hours per year |
|---|---|---|---|---|
| Semester | Credits | | | |

N: Levels

P: Programme requirements

O: Objective

C: Content

B: Bibliography

I: Additional information

## ABBREVIATIONS

### TYPE OF COURSE

| | |
|---|---|
| Attest. | Attestation |
| C | Course |
| C/S | Course - seminar |
| Cp | Camp |
| E | Exercises |
| Exc | Excursion |
| Lg | Guided lecture |
| S | Seminar |
| T | Fieldwork |
| TP | Practical work |

### STATUS

| | |
|---|---|
| Fac | Facultative |
| Obl | Compulsory |
| Opt | Optional |
| Fac/Comp/Opt | Facultative, compulsory or optional (according to the study programme) |

### SEMESTER

| | |
|---|---|
| Sp | Spring |
| A | Autumn |

## SCIENTIFIC RESEARCH IN ALL ITS FORMS - THEME FOR 2014-15: COOPERATION AND KINSHIP

Christine Clavien

| | | | | |
|---|---|---|---|---|
| C | Opt | 2 | french | 14 |
| A | 1.50 | | | |

N: Master

P: * Bachelor degree * Passive knowledge of French

O: - Integrate technics & scientific methods from different academic fields
- Synthesize information from different disciplines
- Transpose knowledge & results from one academic field to another
- Argue in the context of an online discussion forum

C: This course offers a multidisciplinary perspective on the influence of kinship (or family networks) on cooperative interactions. While addressing this topic, speakers from different faculties will shed light on their own way of practicing research.

I: http://www.unil.ch/sciencesaucarre/page86487.html

## SEMINARS OF THE DEPARTMENT OF ECOLOGY AND EVOLUTION

Claus Wedekind

| | | | | |
|---|---|---|---|---|
| S | Obl/Opt | 1 | english | 14 |
| A | 1.00 | | | |

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|---|---|---|---|---|
| S | | | english | 14 |
| S | | | | |

N: Master

P: All seminars and discussions are in English

O: Learn about the current research of other groups and meet international experts.

C: International experts present their research and answer to questions in public.

## BIOLOGICAL SECURITY

Patrick Michaux

| | | | | |
|---|---|---|---|---|
| C | Obl | | french | 3 |
| A | | | | |

N: Master

P: A basic knowledge of microbiology and vegetal science

O: To familiarise future researchers with legislation concerning genetic engineering. In addition, possible biological risks associated to different applications of this technology will be discussed with the help of examples.



LIST OF COURSES

C: * Legislation: article 24 of the Federal Constitution; law concerning environmental protection; law concerning epidemics; ordnance on protection against major accidents; Swiss commissions on biological security: notification and registration of projects.
* Biological security in the laboratory: containment; security equipment; technical measures: laboratory construction; standard laboratory (microbiological) practice; classification of biological material: plasmids, microorganisms, cell lines, primary cells; security levels 1-4.
* Release of genetically modified bacteria in the environment: monitoring, survival and dissemination, ecological impact, transfer of genes, containment systems.
* Potential biological risks associated with the use of transgenic plants: dissemination, cross-pollination, gene transfer.
* The problem of recombinant vaccines: vectors, DNA vaccines.
* Somatic genetic therapy I: Illnesses accessible to treatment by somatic genetic therapy, gene transfer methods.
* Somatic genetic therapy II: Evaluation of the biological risk for the patient and his environment.

## MOLECULAR GENETICS

Luca Fumagalli, Ian Sanders

| | | | |
|---|---|---|---|
| C | Obl | english | 14 |
| A | 4.50 | | |

| | | | |
|---|---|---|---|
| TP | Obl | english | 42 |
| A | | | |

N: Master

O: The objective of this course is to learn the relevant molecular tools that are currently used in ecology, evolutionary and conservation biology research and understand why and when to apply them.

C: This course covers the reasons why molecular genetics is a necessary tool in many ecology, evolution and conservation biology projects. We study its uses and then look at at selection of techniques, particularly for looking at polymorphism, that are not traditionally taught in molecular cell biology courses. Man of the techniques can only be learnt in the classroom as there is not enough time in a week to practically learn all useful techniques. Therefore, the associated laboratory class cover some of the fast techniques that are useful for studying polymorphisms in populations.

B: The course is mostly based on publications in international journals rather than one specific book. The publications are made available in pdf format at the beginning of the course.

## INTRODUCTION INTO SCIENTIFIC WRITING I

Thomas Flatt

| | | | |
|---|---|---|---|
| C | Obl/Opt | english | 7 |
| A | 1.50 | | |

| | | | |
|---|---|---|---|
| E | Obl/Opt | english | 9 |
| A | | | |

N: Master

P: Lecturing and paper writing are in English.

O: Synposis of the major course aims in English:
This short but intensive block course introduces students to the practice of scientific writing (and aspects related to getting published in peer-reviewed scientific journals).
We will discuss questions such as:
Why is it important to publish?
What is good/clear versus bad/unclear (scientific) writing?
How to learn how to write well?
How to structure and write a good scientific manuscript?
The submission, editorial and reviewing process.
How to review someone elses paper?
Publishing is of key importance in scientific research: your job as a scientist is not finished until you have published your results - science is to a very large extent about effectively communicating your results and insights, i.e. what you have learned about how nature works. The ultimate aim of this intensive course is thus to equip students with a solid understanding of how to effectively communicate their research in writing.

C: The course includes both lectures and practical exercises in class, distributed over four half-days. The lectures will give a broad and brief overview of different aspects of scientific writing and publishing; however, the major emphasis of the course is on practical work on part of the students. During the practical parts the students will learn, from scratch, the fundamental structure and essential components of scientific writing, how to write effective outlines/drafts and - most importantly - how to write complete, clear, well-structured papers. These practical exercises will thus require students to do reading and writing assignments, often under a bit of time pressure. At the beginning the exercises will be worked on by teams of 2-4; towards the end, each student will work individually. Finally, to get a grade for this class, students will have to complete 2 written reports (homework assignments). For each exercise as well as for the written reports we will give detailed and individualized feedback.
Detailed Program
Day 1: Lecture 1: Writing papers: the basics of why and how. We will discuss the following: Overview of class and organizational things (incl. homework assignments). Why is it important to publish? What is good/clear versus bad/unclear (scientific) writing? How to learn how to write well? [We will also briefly touch upon issues of good scientific practice and conduct, and various ethical issues connected to publishing.] Approx. 1 hour.
Day 1: Practical work 1. How to think of an effective title and how to write a succinct abstract. In groups of 2-3. Read the assigned (stripped down and short) manuscript and come up with a title and with keywords. Then write a short abstract (< 200 words). We will then discuss the solutions you have come up with, and their potential pros and cons, together in class. Approx. 3 hours.
Day 2: Lecture 2: How to write a scientific paper. We will discuss the basics and essentials of writing a scientific paper (and also what not to do!). Specifically, I will explain how a paper should be structured and sub-structured, how to draft a paper (i.e., how to get started), how to build and complete a full manuscript, and then how to improve it by continuous and agressive revising and re-revising. I will also give you hints and tips for effective writing. Approx. 1 hour.
Day 2: Practical work 2. Writing your own paper in a nutshell. I will give you some data/results (e.g., data figures/tables/legends/statistical outcomes) to choose from. Form a team of 2-3. Ask yourself: What do the results/tables/figures/analyses show and mean? Then prepare a very short mini-paper (1 page max), including: Title, Abstract, Introduction, Materials and Methods, Results, Discussion and Conclusion (there are some other components in a paper that we will skip for the sake of this exercise). Each component should be between 1 and 3-4 sentences maximum. We will then discuss your solutions and their potential pros and cons together in class; I will then give you detailed feedback on your papers by e-mail within 1 week of the exercise. Approx. 3 hours.
Day 3: Lecture 3: How to write a scientific paper: recap. We will briefly recapitulate what we have discussed and learned so far. Approx. 30 min - 1 hour
Day 3: Practical work 3: Review a paper. What distinguishes a good from a bad
manuscript? Now you are the reviewer! Being a critical reviewer will help you to learn to distinguish between good and bad writing and thus help you to improve your own scientific writing. You will be given 2 short, stripped-down manuscripts. Team up in groups of 2-3. Read both manuscripts critically, then make pro and contra lists for both manuscripts. Briefly explain why you would accept/reject (or reach some other decision) the manuscript for publication (

## ANIMAL COMMUNICATION AND PARASITISM

Philippe Christe, Alexandre Roulin

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| A | 1.50 | | |

N: Master

P: None

O: Across the animal kingdom, individuals of the same species differ in their propensity to take risks, and explore new environments, and to be active, aggressive or sociable. Individual differences in behaviour that are consistent through time and across contexts are coined 'personalities', 'behavioural syndromes' or 'temperaments'. The terminology of personality is not a mere fashionable label of something usually studied by behavioural ecologists, but useful to conceptualize the common phenomenon that individuals differ markedly and consistently in their behavioural phenotypes across ecological and social contexts. The notion of personality implies that suites of behaviours are correlated within individuals and hence individuals are less flexible than would be expected under optimality models. In this course, I propose to study personality from an evolutionary point of view and also the evolution of language.

C: This lecture is interactive and illustrated by recent research articles.
7h will be given by A. Roulin and 7h by P. Christe

B: Réale, D., Reader, S.M., Sol, D., McDougall, P.T. & Dingemanse, N.J. (2007). Integrating animal temperament within ecology and evolution. Biol. Rev., 82, 291-318.
Sih, A., Bell, A.M., Johnson, J.C. & Ziemba, R.E. (2004). Behavioral syndromes: an integrative overview. Q. Rev. Biol., 79, 241-277.
Journaux scientifiques figurant à la bibliothèque du Biophore ou sur internet (http://perunil.unil.ch/perunil/periodiques/).

I: Aucune

## POPULATIONS GENETIC AND DYNAMIC

Jérôme Goudet

| | | | |
|---|---|---|---|
| C | Opt | english | 7 |
| A | 1.50 | | |

| | | | |
|---|---|---|---|
| E | Opt | english | 10 |
| A | | | |

N: Master

P: An introductory course in population genetics and population dynamics, and a good understanding of the notions developed in Nicolas Perrin's course, "Biologie des populations"

O: Gain an understanding of how genetics and genomics interact with demographic and selective processes.
website:
http://www2.unil.ch/popgen/teaching/popgendyn2014/

C: In the first part of the course, selected papers from the
recent literature are presented by students and discussed in a
journal club format.
In the second part, in groups of 2-3 students you will use
computer simulations and the quantiNemo program (http://www2.unil.ch/popgen/softwares/quantinemo/) to investigate questions such as:
-efficacy of selection in the face of gene flow?
-effect of the number of loci encoding a trait on the speed of
adaptation
-is neutral diversity a good proxy for adaptive diversity?

I: http://www2.unil.ch/popgen/teaching/popgendyn2014/

## SPATIAL ANALYSIS AND GIS IN ECOLOGY

Antoine Guisan

| | | | |
|---|---|---|---|
| E | Opt | english | 10 |
| A | | | |

| | | | |
|---|---|---|---|
| C | Opt | english | 7 |
| A | 1.50 | | |

N: Master

P: Basics in statistics and ecology

O: Teaching students the basics of GIS and remote sensing, as well as the main spatial methods available in spatial ecology.

C: 1. Introduction to GIS
2. Introduction to remote sensing
3. Raster analyses
4. Neighbourhood analyses
5. Spatial interpolation
6. Detection of spatial structures and patterns

B: Wadsworth, R. & Treweek, J. 1999. Geographical Information Systems for Ecology
Caloz, R. & Collet, C. 2002. Précis de télédetection, vol. 3. Presses Univ. du Québec
Turner, Gardner, O'Neill 2001. Landscape Ecology in Theory and Practice: Patterns and Process. Springer
Dale, Birks, Wiens 2000. Spatial Pattern Analysis in Plant Ecology. Cambridge University Press.
Klopatek, J.M. & Gardner, R.H. 1999. Landscape Ecological Analysis: isuues and applications. Springer.
Hunsaker, C.T., Goodchild, M.F., Friedl, M.A. and Case, T.J. (Eds). 2001. Spatial uncertainty in ecology. Springer.
Hansson, L., Fahrig, L. and Merriam, G. 1995. Mosaic Landscapes and Ecological Processes. Chapman & Hall.

I: http://www.unil.ch/ecospat

## THE MAJOR TRANSITIONS IN EVOLUTION

Laurent Keller

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| A | 1.50 | | |

N: Master

P: none

O: Understand how life has become increasingly more complex during the course of evolution on earth

C: We will addres the major transitions of life, including the evolution of multicelularity, evolution of sex and emergence of animal societies and language in humans

B: La bibliographie sera déterminée lors du cours

## PHYLOGEOGRAPHY

Luca Fumagalli

| | | | |
|---|---|---|---|
| C | Opt | english | 7 |
| A | 1.50 | | |

| | | | |
|---|---|---|---|
| E | Opt | english | 10 |
| A | | | |

N: Master

B: Avise JC. 2000. Phylogeography. Harvard University Press.

## PROBLEM-BASED LEARNING IN BIOLOGICAL MODELS

Paul Franken

| | | | |
|---|---|---|---|
| C | Opt | english | 7 |
| A | 3.50 | | |

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|---|---|---|---|
| E | Opt | english | 35 |
| A | | | |

N: Master

## ADVANCED DATA ANALYSIS IN BIOLOGY I

Frédéric Schütz

| | | | |
|---|---|---|---|
| C | Obl/Opt | english | 6 |
| A | 2.00 | | |

| | | | |
|---|---|---|---|
| TP | Obl/Opt | english | 6 |
| A | | | |

N: Master

## ADVANCED DATA ANALYSIS IN BIOLOGY II

Frédéric Schütz

| | | | |
|---|---|---|---|
| C | Opt | english | 6 |
| A | 2.50 | | |

| | | | |
|---|---|---|---|
| TP | Opt | english | 6 |
| A | | | |

N: Master

## BIOLOGICAL CONSERVATION OF THE MEDITERRANEAN REGION

Alexandre Roulin

| | | | |
|---|---|---|---|
| T | Opt | english, french | 40 |
| A S | 1.50/2.00 | | |

N: Master

P: None

O: Faunistic knowledge on birds, insects, crustaceans, mammals and reptiles with an emphasis on conservation issues. We will visit several places (Extermadura, Andalucia around the Doñana national parc, Tarifa and Brazo del Este) where the fauna is fundamentally different and habitats have suffered from human activities to different degrees.

C: Excursions and group field work. Discussion of scientific articles about conservation issues of Spanish endangered species. Additionnally, each student shall be responsible for the study of one endangered species. Discussion of projects that could be carried out in Spain to answer questions on evolutionary biology, behavioural ecology and conservation.

B: Polycopié distributé aux participants

## FIRST STEP PROJECT

Christian Fankhauser, Olivier Staub, Claus Wedekind

| | | | |
|---|---|---|---|
| TP | Obl | english | 224 |
| A | 15.00 | | |

| | | | |
|---|---|---|---|
| TP | Obl | english | 230 |
| A | 15.00 | | |

| | | | |
|---|---|---|---|
| TP | Obl | english | 250 |
| A | 14.00 | | |

N: Master

P: Practicals performed during the bachelor (molecular biology, genetics, biochemistry, bioinformatics)

O: - An initiation to the work of a scientist
- Conduct experimental work in research lab (wet bench or in silico)
- Interpretation of research results
- Implement basic principles in experimental design (e.g. include the appropriate controls, statistical significance of the results etc...)
- Present your experimental work in a written report which will be organized like a typical research article (intruduction, results, discussion, materials and methods)
- present your work orally (seminar style)

C: Perform laboratory work for about 12 weeks during the time when the student does not follow theoretical classes. This research project will typically be performed under the guidance of a PhD student or a post-doc from the host laboratory.

## EVOLUTIONARY BIOLOGY WORKSHOP

Tadeusz Kawecki

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 3.00 | | |

| | | | |
|---|---|---|---|
| TP | Opt | english | 32 |
| S | | | |

N: Master

P: Background knowledge and interest in evolutionary biology

O: The main goals are to develop the following skills:
- developing your scientific ideas through discussions in groups
- thinking critically and expressing oneself clearly
- turning a general idea into a research project
- writing a grant proposal and defending it
- doing it all in English

C: Teachers :
DEE: Tadeusz Kawecki, Ian Sanders
Invited Professors:
Mark Kirkpatrick (University of Texas, Austin)
John Taylor (University of California, Berkeley)
Target participants: advanced Master students and PhD students from University of Lausanne and from other universities in Switzerland and abroad.
This course is based on a concept developed by Steve Stearns and John Maynard Smith and implemented in their "Guarda" workshop (organized by the University of Basel since 1987). It has a character of a retreat; it takes place in a beautiful small Alpine village (La Fouly), which will allow you to focus while being able to enjoy the landscape and the Alpine flora.
It is you, the students, who will be in charge in this course. You will work with your ideas, you will decide yourself what the important questions in broadly defined evolutionary biology are, you will choose one, and propose a research project that will address it. The faculty will visit the groups during the discussions to answer your questions and provide coaching and they will give you feedback on your proposal, but they will generally take the back seat. Additionally, the faculty will give informal talks about their research and be available for informal discussion with individual students.
Provisional schedule:
Day 1: arrival in the afternoon; students are divided in groups of 4-5. A research talk.
Day 2: Discussions in groups (3 sessions), faculty visit the groups on rotational basis. A research talk in the evening.
Day 3: Discussions in groups, proposal writing. The first version of the proposal due at dinner time. After dinner feedback by the faculty.
Day 4: Morning: free half-day for hiking/birdwatching/botanizing/relaxing. Afternoon: groups continue working on the proposals. A research talk in the evening.
Day 5: Groups continue working on the proposals, the second version delivered in the evening. A research talk.
Day 6: Morning: groups get feedback about their proposals and prepare presentations. Each group presents their project to the other groups; this is run by the students, the faculty sit back. Evening-next morning: a grill party.
Day 7: cleaning up and departure.

## BIOLOGY OF INVASIVES SPECIES

Daniel Cherix

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

P: knowledge of fauna and flora

O: To understand the fundements of biological invasions in relation to conservation biology

C: Introduction - Origin and basics of biological invasion - Characteristics of invasive species - Diffusion mechanisms - Ecological consequences. Examples are taken in Switzerland, Europe and World, including animal species and plant species regarding accidentally introduced species, voluntary introduced species, re-introductions and extensions

B: Neobiota volume 3, 2004. « Biological Invasions - Challenge for Science » Ingolf Kühn and Stefan Klots (Eds.), Neobiota volume 6, 2005. « Biological Invasions - from Ecology to Control" Wolfgang Nentwig, Sven Bacher, Matthew J.W.Cock, Hanjörg Diez, Andreas Gigon & Rüdiger Wittenberg (Eds).

## CO-EVOLUTION, MUTUALISM AND PARASITISM

Ian Sanders

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

P: Must understand english and be prepared to give presentations

O: To understand the evolutionary consequences of organisms living together in mutualism or parasitism and how to investigate it experimentally

C: The course comprises some introductory talks given by me about concepts in co-evolution and theoretical frameworks for studying co-evolution. Afterwards, students give presentations on chosen key publications in this field and the group discusses these subjects after the presentations.

B: : All bibliography is made availble in pdf format before the course begins. For an example of the publications discussed you can find last years publications in my docunil public folder.

## APPLIED ECOLOGY

Jérôme Pellet

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 2.50 | | |

| | | | |
|---|---|---|---|
| TP | Opt | english | 28 |
| S | | | |

N: Master

P: BSc level in biology, including ecology

O: Applied ecology is a young crisis discipline undergoing a major effectiveness revolution. In most situations, urgent action is necessary, even in the absence of reliable information. How do we gather sound ecological information? How do we use it to plan natural communities conservation? In the process of answering these questions, wildlife ecologists often realize that research and practice are just two sides of the same coin.

C: The goal of the course is to teach students some of the skills they will need as evidence-based conservationists. Practical examples will be drawn from various ecosystems, communities and species. The course will revolve around the stages of adaptive management:
– monitoring ecological resources, monitoring occupancy and abundance
– research syntheses (systematic reviews and meta-analyses)
– ecological triage (systematic conservation planning and red lists)
– natural communities conservation planning and legislative context.
Field-based case studies will provide students an opportunity to apply and discuss some of the principles illustrated in the course. Practical work will include meeting with practitioners, discussing and analyzing their approach and methods through the prism of adaptive management.
« There is no such thing as a special category of science called applied science; there is science and its applications, which are related to one another as the fruit is related to the tree that has borne it. » Louis Pasteur

## HONEYBEE ECOLOGY, EVOLUTION AND CONSERVATION

Vincent Dietemann

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

O: This series of lectures will show the complexity of insect societies and will give the opportunity to see how concepts learned elsewhere by the students can be placed within the context of a single species.

C: Since honeybees are economically important insects, they have been studied early in history and the knowledge we possess about them is greater than for any other social insect. Our understanding of the honeybee reveals the complex organisation reached by insects when they form societies. This series of lectures will present some aspects of this complexity that will be replaced within its evolutionary context. Various aspects of honeybee ecology and evolution, including geophylogeny, biology, reproduction at individual and colony level, division of labour, communication, economical value, pathogens will be presented.
After a general introduction of this model species describing the diversity and biogeography of the taxon, we will dissect the communication abilities of European honeybees and compare it with related Asian species. We will see how this communication is used to organise foraging tasks sustaining colony growth. Reproductive conflicts will be described to show that the altruism commonly attributed to the colony members is tainted by selfishness. Honeybee health is a current concern and we will review the pathogens affecting them and comment the role of humans in their spread and control in an evolutionary context. Since honeybees are globally threatened, we will see what economical losses their decline could have and some conservation projects to invert the trend will be put in context.

B: Seeley T, 1985. Honeybee Ecology. Princeton University Press.
Seeley T, 1995. The wisdom of the hive. Harvard University Press.
Moritz RFA, Southwick EE, 1992. Bees are superorganisms. Spiringer Verlag
Oldroyd B, Wongsiri S, 2006. Asian Honey Bees. Harvard University Press.
Koeniger N, Koeniger G, Tingek S, 2010.Honey Bees of Borneo. Natural History Publications
Winston ML, 1987. The Biology of the honey bee. Harvard University press.

## ECOLOGY OF THE FISHES OF SWITZERLAND

Jean-François Rubin

| | | | |
|---|---|---|---|
| C | Opt | english | 7 |
| S | 1.50 | | |

| | | | |
|---|---|---|---|
| TP | Opt | english | 10 |
| S | | | |

N: Master

P: none

O: Recognize the different habitats and species
Know the biology of the principal species
Identify the problems linked to the management of these habitats and species

C: Generalities on water
Lakes
Watercourses
Plankton and plants
Systematic of fish
Anatomy of fish
The fish of Switzerland

## EVOLUTION OF LIFE HISTORY AND AGING

Thomas Flatt

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

P: This is an advanced course for students with a solid background in evolutionary ecology, evolutionary genetics and quantitative genetics with a strong interest in understanding Darwinian fitness and natural selection. The course will be strongly based on a book by Stearns (Stearns, S.C. 1992. The evolution of life histories. Oxford: Oxford University Press). The course requires proficiency in English and the willingness to actively engage in discussing, asking questions, reading, presenting material, etc. An understanding of basic statistics and mathematics (including calculus) is helpful. At the end of the course, the students will take an oral exam.

O: (1) To learn about fundamental concepts in evolutionary biology in the context life history evolution.
(2) To learn what fitness and life history traits are; to learn how life history traits evolve; and to understand the diversity of different life history strategies among different organisms and environments.
(3) To learn what life history trade-offs are; to learn what life history plasticity and reaction norms are.
(4) To learn how we can understand the existence of aging, as well as differences in lifespan and the rate of aging among individuals and among species, by using evolutionary thinking.
(5) To learn about why life history evolution is one of the major explanatory frameworks in evolutionary biology. To be able to define its main concepts and explain its main approaches and limitations.
(6) To be able to explain fundamental concepts in evolutionary biology to lay persons using examples from life history evolution.
(7) To be able to explain to lay persons why evolution matters in terms of explaining why organisms age and die.
(8) To improve your ability to have educated conversations about science in English.
(9) To improve your ability to read and understand scientific texts in English.

C: This course introduces the field of life history evolution, a branch of evolutionary ecology and evolutionary genetics that deals with the evoluton of fitness-related traits. A female North Pacific Giant Octopus (Enteroctopus dofleini) lives three to four years; it lays thousands of eggs in a single bout and then dies. By contrast, a mature Coast Redwood Tree (Sequoia sempervirens) lives for many hundreds of years and produces millions of seeds each year. As these examples illustrate, organisms differ dramatically in how they develop, the time they take to grow, when they become mature, how many offspring of a particular size they produce, and how long they live. Together, the age-, size-, or stage-specific patterns of development, growth, maturation, reproduction, survival, and lifespan define an organism's life cycle, its life history. The principal aim of the field of life history evolution is to explain the remarkable diversity in life histories among species. But there is another, more compelling reason for why life history evolution is important: adaptation by natural selection is based on variation in Darwinian fitness among individuals, and since life history traits determine survival and reproduction they are the major components of fitness. The study of life history evolution is thus about understanding adaptation, the most fundamental issue in evolutionary biology: to explain the remarkable diversity of life histories among species we must understand how evolution shapes organisms to optimize their reproductive success. I will introduce the basics of life history theory and review what biologists have learned about life history evolution. A particular focus of the course will be on lifespan and aging: Why do we age? And why does natural selection not prevent such a deleterious process? In the course we will discuss evolutionary explanations for why organisms grow old and die. In addition to these evolutionary concepts and explanations, we will also discuss the genetic and physiological mechanisms underyling the evolution of life histories and aging. The course will consist of a series of interactive overview lectures, mixed with reading/discussion sessions.
Parts:
(1) Overview of life history theory
(2) Basic demography
(3) Quantitative genetics and reaction norms
(4) Age and size at maturity
(5) Number and size of offspring (Clutch Size and Reproductive Investment)
(6) Reproductive lifespan and aging
Remark no. 1: The overview lectures should be followed and these lecture notes be used in conjunction with reading the chapters in Stearns' 1992 book.
Remark no. 2: We won't cover sex allocation theory; modular life histories; complex life histories. Most of the material presented is based on animal life histories, not plant life histories.

B: - Fabian, D., and T. Flatt. 2012. Life history evolution. Nature Education Knowledge 3(10):24.
- Fabian, D., and T. Flatt. 2011. The evolution of aging. Nature Education Knowledge 3(10):9.
- Flatt, T., and Heyland, A., eds. (2011). Mechanisms of Life History Evolution - The Genetics and Physiology of Life History Traits and Trade-Offs. (Oxford: Oxford University Press).
- Flatt, T., and Schmidt, P.S. (2009). Integrating evolutionary and molecular genetics of aging. Biochimica et Biophysica Acta 1790, 951-962.
- Roff, D.A. (1992). The Evolution of Life Histories: Theory and Analysis. (New York: Chapman and Hall).
- Rose, M.R. (1991). Evolutionary Biology of Aging (New York and Oxford: Oxford University Press).
- Stearns, S.C. (1992). The evolution of life histories. (Oxford: Oxford University Press).
- Stearns, S.C. (2000). Life history evolution: successes, limitations, and prospects. Naturwissenschaften 87, 476-486.

## EVOLUTION OF SEX DETERMINATION

Nicolas Perrin

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

## SOCIAL EVOLUTION

Laurent Lehmann

| | | | | |
|---|---|---|---|---|
| C | Opt | | english | 14 |
| S | 1.50 | | | |

N: Master

O: The goal of the course is to introduce the student to the foundations of social evolution and to an understanding of the main selective forces underlying the emergence of cooperation, altruism, and conflict within animal societies.

C: The course will consist of an analysis of various models of social interactions (games) by using and providing an introduction to evolutionary game theory and inclusive fitness theory. These models will include the analysis of one shot interactions settings, such as the prisoner's dilemma, the stag-hunt, and the snow-drift games, as well as multimove games including reciprocity and reputation. Models for the evolution of punishment and policing will also be analysed, along with tragedy of the commons type of situations and their resolutions. Interactions occurring in well mixed as well as in family and spatially structured populations will be considered. The course will emphasize the similarities and differences between all these situations.

## CONSERVATION GENETICS

Luca Fumagalli

| | | | | |
|---|---|---|---|---|
| C | Opt | | english | 14 |
| S | 1.50 | | | |

N: Master

P: None

O: To give a comprehensive introduction to genetic principles involved in conservation

C: loss of genetic diversity in small populations; inbreeding and loss of fitness; population fragmentation; management of intraspecific genetic diversity; genetic management of captive populations; non-invasive genetic sampling; fragmented populations and translocations; genetically viable populations; forensic zoology; detecting hybridization

B: - Frankham, Ballou & Briscoe. 2002. Introduction to Conservation Genetics. Cambridge University Press.
- Avise & Hamrick. 1996. Conservation Genetics: case histories from nature. Chapman & Hall.
- Allendorf & Luikart. 2007. Conservation and the Genetics of Populations. Blackwell Publishing.

## SCIENTIFIC MEDIATION AND COMMUNICATION

Alain Kaufmann, Liliane Michalik

| | | | | |
|---|---|---|---|---|
| C | Opt | | french | 28 |
| S | 3.00 | | | |

N: Master

## PREDICTIVE MODELS OF SPECIES' DISTRIBUTION

Antoine Guisan

| | | | | |
|---|---|---|---|---|
| C | Opt | | english | 14 |
| S | 2.50 | | | |

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|---|---|---|---|---|
| E | Opt | | english | 14 |
| S | | | | |

N: Master

P: Spatial analyses course from previous semester (not strictly required).

O: Predictive habitat distribution models are being increasingly used in conservation biology, to predict the distribution of species and higher levels of biological organization (e.g. communities, biomes). This course intend to present the main approaches used, and their main domains of applications: invasive species, rare species, climate change impacts, reserve design and so on. The course will be supported by computer exercises

C: Chap 1. General introduction. Biological theory behind these models, niche concepts, species assemblages, pseudo-equilibrium, competition, dispersal, spatial autocorrelation, niche conservatism, model robustness ; Overview of main predictive approaches ; required data and associated sampling designs.
Chap. 2. Presence-only models. Problem of obtaining absences, use of pseudo-absences, related theory, use vs unused habitats, use vs available, specific predictive approaches and evaluation.
Chap. 3. Presence-absence/abundance/diversity models. Statistical theory behind these models, probability distributions, model fitting, maximum likelihood regression, predictor selection, link between statistical models and ecological theory, implementing the models in a GIS, uncertainty mapping,p/a, abundance and diversity measures and related models (binomial, Poisson, ordinal, etc..); predictions and evaluation.
Chap. 4. Model evaluation: for p/a, po, abundance/diversity. Internal (resampling) vs external (truly independant data.) evaluation: cross-validation, jackknife, bootstrap, transfer into distinct area
Chap. 5. Modelling species assemblages - reconstructing communities/diversity. Multi-species models : CCA, multivariate CART, multivariate ANN - assemblages predictions from individual species models - alternative approaches (e.g. GDM, Global Dissimilarity Modelling)
Chap. 6. Deriving climate change impact scenarios- migrations d'espèces et incertitudes dans les projections. Range shifts, projections uncertainties, implications for conservation

B: Guisan, A. & Zimmermann, N.E. (2000). Predictive habitat distribution models in ecology. Ecological Modelling 135(2-3): 147-186.
Guisan A, Thuiller W (2005) Predicting species distribution: offering more than simple habitat models. Ecology Letters, 8, 993-1009.

I: http://www.unil.ch/ecospat

## PHYLOGENY AND COMPARATIVE METHODS

Nicolas Salamin

| | | | | |
|---|---|---|---|---|
| C | Opt | | english | 7 |
| S | 1.50 | | | |

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|---|---|---|---|---|
| E | Opt | | english | 14 |
| S | | | | |

N: Master

P: none

O: Phylogenetic reconstruction methods and their application in evolutionary biology. To know and understand phylogenetic reconstruction methods in order to test the processes leading to genes and organisms evolution.

C: The subjects will be presented during lectures as well as practicals.
I. Reconstruction methods
- What is a phylogenetic tree and how to interpret it?
- Tree reconstruction:
a) optimisation criteria and models of evolution
b) search for the optimum tree
c) Bayesian methods
- Can we trust the inferred tree?
II. Uses for phylogenetic trees
- Detecting positive selection in a coding gene
- Testing coevolution and cospeciation
- Macroevolution:
a) dating evolutionary events
b) tempo and mode of evolution
c) testing for key innovations
- Phylogeny and conservation

B: Felsenstein, J. 2003. Inferring phylogenies. Sinauer Associates.
Page, R. 2003. Tangled trees: Phylogeny, cospeciation, and coevolution. University of Chicago Press.
Purvis, A., Gittleman, J.L. and Brooks, T. 2005. Phylogeny and conservation. Cambridge University Press.
Swofford, D.L., Olsen, G.K., Waddell, P.J. and Hillis, D.M. 1996. Phylogeny reconstruction. Pages 407-514 In Molecular Systematics (D.M. Hillis, C. Moritz, B.K. Mable, eds.). Sinauer Associates.
Yang, Z.H. 2006. Computational Molecular Evolution. Oxford University Press.

I: http://www.unil.ch/phylo/teaching/pmc.html

## SEXUAL SELECTION

Patrick Stefan Fitze

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

## ECOLOGY AND FAUNISTICS OF THE SEA SHORE, ROSCOFF

Nicolas Perrin

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|---|---|---|---|
| T | Opt | english, french | 56 |
| S | 3.00 | | |

N: Master

P: !!! Please, contact the person in charge before your inscription !!!

O: To allow a first, integrated approach of the itertidal biotope, and to understand the role played by the tides, the substrate and other conditions on the faunistic composition of littoral communities and on the physical and behavioural adaptations of the species.

C: Lecture (6 h): Introduction to intertidal ecology.
Excursions and group field work: analysis of zonation and biodiversity in various habitats (sand beach, rock, estuaries and so on). Additionnally, each student shall be responsible for the study of one taxonomic group.
Lab experimentations: experimental design and realisation of an experiment in etho-ecology illustrating adaptative behaviour of an intertidal species.

## MATING STRATEGIES AND SEX AMONG PLANTS

John Pannell

| | | | |
|---|---|---|---|
| C | Opt | english | 7 |
| S | 1.50 | | |

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|---|---|---|---|
| TP | Opt | english | 14 |
| S | | | |

N: Master

O: To discover some of the remarkable diversity of plant reproductive systems
To explore hypotheses for the function and evolution of several key sexual-system polymorphisms
To understand the ways in which plant reproductive traits have evolved in the context of ecological and genetic interactions

C: The course will comprise a mix of:
1. lecture material presented to students
2. exercises aimed at securing a conceptual understanding of the key topics explored
3. discussion and presentation of research papers dealing with important concepts in the evolution of plant mating and reproduction.

## CURRENT PROBLEMS IN CONSERVATION BIOLOGY

Claus Wedekind

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 3.00 | | |

| | | | |
|---|---|---|---|
| E | Opt | english | 14 |
| S | | | |

N: Master

P: Lectures, discussions, and proposal writing in English.

O: Introduction into
- some important problems of conservation biology
- funding opportunities for conservation projects
- the planning and writing of grant proposals
- peer reviewing of grant proposals
Own ideas shall be developed, presented and discussed in class.

C: Some current research topics within the field of conservation biology will be further introduced in lectures, guest lectures, and discussion in class. Each student then develops an own idea of a research project within these topics. After an introduction into funding agencies and the planning and writing of grant proposals, each student (or groups of two) write(s) up an own proposal and present(s) it to the class. The proposals of colleagues will then be peer-reviewed after an introduction into peer-reviewing of grant proposals.

## BEHAVIOUR AND BEHAVIOURAL ECOLOGY OF SOCIAL INSECTS

Christoph Grüter

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

O: The aim of this course is to learn about the fascinating world of social insects

C: Social insects are an extremely diverse animal group of major ecological, economic and scientific importance. The course will mainly focus on ants, bees, wasps and termites. We approach behaviour and behavioural differences between species from an ecological and evolutionary perspective. Why is there division of labour and why does it differ between species? What is self-organisation and how does it work? Why do some ant queens mate with 10 males while others are strictly monogamous? Why do termites have exploding bodies and why do stingless bees build prisons for virgin queens? These are some of the topics we will discuss.

B: Hölldobler B. & Wilson E.O. (2009) The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies. W. W. Norton & Company, New York.

## EVOLUTIONARY CONSEQUENCES OF HYBRIDIZATION AND WHOLE GENOME DUPLICATION

Nils Arrigo

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

## ANTI-INFECTIVE AGENTS

Dominique Sanglard

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|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

O: Description:
The aims of this class is to understand the mode of action and resistance to principal anti-infective agents used for the therapy of infectious diseases. Diverse classes of agents will be discussed which are used to combat bacterial, viral, fungal and parasitic infections. The molecular basis of resistance to these agents will be also illustrated by several examples.
The class is also associates with paper reading and presentations
Learning outcomes:
- to learn about the mode of actions of anti-infective agents
- to learn about molecular resistance mechanisms developing in microbial pathogens.

C: Part Ciuffi: Antiviral agents (2h)
Part Greub and Hauser: antibacterial agents (4 each); paper discussion and presentation
Part Sanglard: Antifingal agents (3h)

## CYTOSKELETON FROM MICROBES TO MAN

Sophie Martin

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

P: A good knowledge of molecular and cellular biology Bachelor-level courses.
Curiosity for cellular processes.

O: The objectives of this course are to:
1) gain general knowledge on the organisation and function of the cytoskeleton in prokaryotes and eukaryotes
2) learn to read scientific articles in a critical manner, by discussing the strong and weak points of each article.

C: The course will introduce the following topics:
- general principles of the actin and microtubule cytoskeleton
- cytoskeletal dynamics (dynamic instability and treadmilling)
- motor proteins
- organisation and role of the cytoskeleton in bacteria
- organisation and role of the cytoskeleton in eukaryotic cells (several themes will be covered, depending on the choice of the articles to be discussed, for instance: mitotic spindle, cell division, cell polarity,...)

B: Les papiers à lire et discuter seront annoncés lors du premier cours

## FROM RECEPTORS TO GENES : SELECTED CHAPTERS OF MOLECULAR ENDOCRINOLOGY

Nicolas Mermod

| | | | |
|---|---|---|---|
| C | Opt | english | 24 |
| S | 3.00 | | |

N: Master

P: Introductory courses in molecular biology, genetics and biochemistry.

O: Presentation of the molecular principles and the mechanisms of regulatory signaling pathways from the cellular membrane to the genes. This will be explored from an experimental point of view, with the help of genetics, molecular biology and biochemistry tools. Special emphasis will be given to the role of particular transcription factors as intermediates of these regulating pathways. Moreover, this course illustrates the coordination between various regulating pathways. Part of the course is given as formal lectures, the other part consisting of round-table discussions on scientific articles.

C: Introduction and reminders
1. General principles of signaling
Transmission of mediated signals by 7 transmembrane domain receptors
2. The cAMP pathway
3. The calcium pathway
4. The diacylglycerol pathway
Transmission mediated signals by 1 transmembrane domain receptors
5. One transmembrane domain receptors
6. The MAP kinase pathway
7. The JAK-STAT pathway
8. Other one transmembrane domain receptors.

I: http://www.unil.ch/biotech/page38684.html

## MICROBIAL ECOLOGY

Jan Roelof Van Der Meer

| | | | |
|---|---|---|---|
| TP | Opt | english | 35 |
| S | 1.50 | | |

N: Master

P: Ideally: The class in Microbial ecology and environmental microbiology (BSc 3, Block Behaviour and ecology)

O: The goals of this practical course are to practice a number of microbial community analysis methods on a complex community such as a wastewater treatment plant.

C: The main methods that will be learned during this practical course are:
- Fluorescent in situ hybridization

Using a set of fluorescently labeled probes directed against the ribosomal RNAs of different taxonomic groups we will study the composition of wastewater communities in the different parts of a treatment plant and relate this to the functional aspects of the treatment process in different stages.
- Terminal restriction fragment length polymorphism

T-RFLP will be used as molecular marker to characterize the same communities as for FISH and to compare the differences and total diversity of the microbial communities in the different parts of the wastewater treatment plant.

## SUPPLEMENT : SEQUENCE A GENOME II AND WRITE A FELLOWSHIP

Jan Roelof Van Der Meer

| | | | |
|---|---|---|---|
| E | Opt | english | 10 |
| S | 1.50 | | |

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|---|---|---|---|
| TP | Opt | english | 10 |
| S | | | |

N: Master

## EPIDEMIOLOGY

Dominique Blanc, Dominique Sanglard

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|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

O: Acquire principles of epidemiology by the study of several examples of pathogens. Knowledge on molecular typing methods and their applications. Knowledge on bacterial population genetics.

C: General concepts. Molecular typing in epidemiology. Bacterial population genetics.
Viral infections: relation between the host range, timing of infection, mode of infection and the resulting epidemiology.
Epidemiology of Staphylococcus aureus.
Epidemiology of Pneumocystis.
Epidemiology of Candida.

## GENOMICS, PROTEOMICS AND QUANTITATIVE GENETICS

Paul Franken

| | | | |
|---|---|---|---|
| C | Opt | english, french | 24 |
| S | 3.00 | | |

N: Master

O: Get acquainted with the various experimental approaches and technologies to address fundamental principles of gene and genome function

C: As stated in the title this course consists of three components. Together these components introduce and give an overview of functional genomics from gene transcription to the protein, and, finally, the phenotype. Besides providing a background, the techniques applied in the various approaches will be emphasized.
Genomic technologies and applications
- Advanced techniques in microarray analysis: Tiling arrays, SNP detection, ChIP on chip experiments.
- Biology of non-coding RNAs and their detection
- qPCR, theory and applications.
Proteomics
- Introduction to expression proteomics (analysis of protein expression levels and their changes) and functional proteomics (functional relationships between proteins).
- Introduction to separation techniques (liquid chromatography, 2D electrophoresis, mass spectrometry), typical workflows in which these techniques can be applied, and bioinformatics analysis.
- Discussion of the potential and limitations of the proteomics approach to study complex biological systems.
Analysis of Quantitative Traits
- Introduction into quantitative genetics.
- How to map quantitative traits in model organisms (mice, fruitfly)?
- Mapping strategies in humans and in non-model organisms.
- Introduction to the use of Quantitative-Trait-Loci mapping tools (WebQTL, MapManager, MapMaker) and statistical issues in QTL mapping.

## HERBIVORY : WHY IS THE EARTH GREEN

Edward Elliston Farmer

| | | | |
|---|---|---|---|
| C | Opt | english | 24 |
| S | 3.00 | | |

N: Master

P: Admission into the Masters programme and Bachelors in biology or a related subject

O: Understand why leaves are so abundant on earth

C: Leaf energetics and herbivore diets, physical defenses, coevolution of leaves and stomachs, molecular targets of leaf defense chemicals, the growth/defence dilemma
Note: this is an interactive, question-based course requiring active participation

B: Fourni sur MyUNIL avant et durant le cours

## MICROBES AS TOOLS IN EXPERIMENTAL BIOLOGY

Dominique Sanglard

| | | | |
|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

O: The general aim of this class is to get detailed knowledge on the use of microbial systems (including viruses, bacteria and yeast) as tools in several fields of experimental biology (microbial pathogenesis, genetic engineering applications, gene therapy).
The class is associated with reading and presentations of paper related to this topic.

C: Part Ciuffi
Description :
The aim of this class is to open up your mind and make you think out of the box, thereby making you look at viruses beyond their pathogenicity and more as potential tools that can be used for many diverse applications.
To appreciate the potential of viruses as tools in molecular biology, this class will give you a non-exhaustive list of applications in which viruses are used as tools.
Examples will include the use of viruses as pesticides, gene delivery vehicles, vaccines, tools in gene expression studies and in cellular biology studies.
Learning outcomes :
- To realize that viruses are not only pathogens.
- To realize that viruses can be used as tools in multiple applications.
- To understand that fundamental knowledge about viruses can be useful for secondary applications.
- To appreciate the diversity of viruses and their differences in replication, and thus the diversity of applications in which they can be exploited.
- To identify the viral steps that can be manipulated. To know how to manipulate these viral steps and why.
- To appreciate impact of viruses in the current society.
Part Sanglard
Description:
The aims of this class is to show the importance of genetic screens for the identification of novel biological functions related to microbial virulence and to therapeutic targets. Specifically, the aims are the following:
- To understand how genetic screens can contribute to identify virulence factors in bacteria and yeast.
- To show how genetic screens can serve the identification of genes involved in the recognition of fungal PAMP by the immune system.
- To show how genetic screens can contribute to identify novel therapeutic targets in pathogenic yeast.
Learning outcomes:
- To appreciate how methodologies can be employed in genetic screens.
- To realize how bacterial and yeast genetics can address and solve biological problems.

## VIRAL PATHOGENESIS AND EMERGING VIRUSES

Stefan Kunz

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|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

P: Cours Virologie BSc. 5th semester (S. Kunz)

O: To understand fundamental principles of viral pathogenesis at the cellular, systemic, and population level.
To cover the pathogenesis of major human viruses and emerging viral diseases.
To discuss the basic concepts of viral pathogenesis in the context of landmark papers in the field.

C: Teaching: Angela Ciuffi, Jérôme Gouttenoire, Stefan Kunz
Basic concepts in viral pathogenesis (S. Kunz)
Major human pathogenic viruses and emerging viral diseases (S. Kunz)
Viral hepatitis (J. Gouttenoire)
Human retroviral infections (A. Ciuffi)
Genome screening approaches in viral infectious diseases (A. Ciuffi)
Introductory lectures will be given by the teachers.
Landmark papers will be presented by students and discussed in the group.

B: Viral Pathogenesis and Immunity. Nathanson, N. (Ed), 2nd Ed. 2007, Academic Press.

## RECOMBINANT PROTEINS : APPLICATIONS IN RESEARCH AND MEDICINE

Blaise Corthésy

| | | | |
|---|---|---|---|
| C | Opt | english | 12 |
| S | 1.50 | | |

N: Master

## BACTERIAL VIRULENCE AND PATHOGENESIS

Gilbert Greub

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|---|---|---|---|
| C | Opt | english | 14 |
| S | 1.50 | | |

N: Master

## PERCEPTION OF ENVIRONMENTAL SIGNALS IN PLANTS

Christian Fankhauser

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|---|---|---|---|
| C | Opt | english | 24 |
| S | 3.00 | | |

N: Master

P: Bachelor classes in plant biology
Good understanding of molecular genetics

O: This course is a combination of lectures and paper reading/discussions. The objective of the lectures is to prepare the students for the scientific papers that they will read and discuss.
Light perception in plants will be studied, in particular
1) How do plants alter their growth and development in response to changes in their light environment.
2) Different photoreceptors in plants
3) Mechanisms of signal transduction from photon perception to induction of a new gene expression program.
4) Interaction between an external factor (light) and the developmental program of plants.
The students will have to critically evaluate scientific papers, summarize the main findings and highlight the weak and strong points of such publications.
This analysis will also include the methodology which is used in those papers. The most commonly used techniques used in the publications are molecular genetics, biochemistry and cell biology.

C: Light perception in higher plants
Historical aspects regarding the identification of plant photoreceptors
Effects of light during the whole life cycle of plants (germination, de-etiolation, vegetative development, transition to flowering).
Circadian clock and photoperiodism (flowering + tuberization). Basics of circadian biology, external coincidence model to explain photoperiodism.
Different plant photoreceptors (UV-B, phytochromes, cryptochromes, phototropins).
Signal transduction, from light perception by the photoreceptor to the physiological response
Interaction between gravitropism and phototropism.
Auxin signaling and transport. This important plant hormone will in particular be covered in relationship with gravi and phototropism.

B: Lorrain, S. Fankhauser C., Les plantes se font une place au soleil, Pour la science, n°49, Nov. 2006.
Chen, M. Chory, J. and Fankhauser, C. Light signal transduction in higher plants. Annual Reviews in Genetics volume 38 pages 87-117 (2004).