1.1.1 Time schedule Topmaster SystemsBiology/Biomolecular Integration (other elements of the program run in parallel mode).

Code of course	*Name of course*	*Responsible*	*EC TS.*	*Period*
	Portal course part 1	Krab	5	06-09-2004 / 01-10-2004
	Molecular microbiology	Oudega	6	04-10-2004 / 29-10-2004
	Integrative Bioinformatics	Heringa	5	01-11-2004 / 24-12-2004
	Portal course part 2	Krab	4	01-11-2004 / 24-12-2004
	Ethics, history of science	General course	5	03-01-2005 / 28-01-2005
	Interacting molecules	Lill	6	07-02-2005 / 04-03-2005
	Proteins: structures, folding and dynamics	Vermeulen/Va der Vies	5	07-03-2005 / 01-04-2005
	Intracellular networks	Westerhoff	5	04-04-2005 / 29-04-2005
	Self-organization and emergence of function	Westerhoff	3	02-05-2005 / 13-05-2005
	Scientific writing in English	General course	3	
	International research project	Westerhoff	65	June 2005, September 2005-June 2006
	Comprehensive exam	Westerhoff	4	June 2006

name **Portal course (parts 1 and 2)**

code

coördinator Dr K. Krab and Prof. Dr. H.V. Westerhoff

lecturers Prof. Dr H.V. Westerhoff, Dr K. Krab, Drs. F. Bruggeman, Dr. F.C. Boogerd, and guests

ECTS 9

Time period September 2004, November-December 2004 (half-time)

aim An intensive course for introduction of students with a Biology bachelor or Medical Biology bachelor (or equivalent) to concepts and methods of physics, chemistry and mathematics as necessary for the rest of the curriculum Systems Biology/Biomolecular Integration.
An intensive course for introduction of students with a Physics, Chemistry of Mathematics oriented bachelor to concepts and methods of Biology and Medical Biology as necessary for the rest of the curriculum Systems Biology/Biomolecular Integration.

Goals:

- Obtain sufficient insight and knowledge across the range from medical biology to mathematics to be able to follow the rest of the topmaster Systems Biology/Biomolecular Integration
- Appreciation and understanding of the importance and motives of the 'other' disciplines
- Ability of the student to engage in thorough scientific discussions with students of the 'other' blood group

contents *Theor.* Introduction to:

- Cell Biology
- Biophysics
- Biochemistry
- Chemistry
- Mathematics
- Molecular genetics
- Physics
- Pathophysiology

Practical:

- short course in experimentation (pipeting, centrifugation, spectrophotometer, mathematical modeling)
- socialization weekend/midweek of the group

methodology

- Lectures
- Tutorials/discussions of book material, lecture notes
- Web-courses
- Computer practicals
- Lab- work: Experiments

literature	• Reader (10 euro) • Molecular Biology of the Cell (‘Alberts’)
teaching	Active participation
test	Written exam
target group	Students with Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology with a strong interest in the interface between these disciplines
remarks	The course is taught in the English language, and involves much direct contact with the professors and associate professors.
Required knowledge	Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology or equivalent (see www.systembiology.net/topmaster)

name **Molecular Microbiology**

code

coördinator Prof. dr. B. Oudega

lecturers Prof. Dr B. Oudega, and the guest-lecturers dr. Luirink, dr. Otto, dr. Harms, Prof. dr. Lill, Prof. dr. Westerhoff, dr. Van Spanning

ECTS 6

Time period October 2004

aim *Goals:*

- To teach the students, theory and practical approaches, and to generate insight into the complex molecular processes in the cell, especially in the bacterial cell. The emphasis is on structueres of the the cell enevelope, protein transport and regulation.

At the end, the students should be able to understand and know:

- fundamental molecular processes that are important for growth and pathogenicity of micro-organisms, regaulation of physiological processes as a function of environmental conditions.
- practical approches in the molecular microbiology area, immunology, bacterial DNA technology , etc

contents *Theory*:

- Lectures on: functional aspects of the bacterial cell envelope, structure and function of membrane components, chaperones and protein folding processes, stress-response, biogenesis of membrane proteins, protein secretion routes, biogenesis and function of fimbriae, iron uptake mechanisms, virulence factors, regulation of gene expresion and DNA structure

Practical:

- for some students laboratory work with several different molecular genetic and molecular microbiology techniques and methods
- for other students, when appropriate, literature stuy and essay-writing

methodology

- Lectures
- Tutorials/discussions of book material, lecture notes
- Laboratory work: students work in small groups (2-3 persons)
- Literature study, writing essay
- Presentations

literature Reader (ca 10 €)

teaching Active participation (October 2004).

test Written exam

target group Students with Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology with a strong interest in the interface between these disciplines

remarks	The course is taught in the English language, and involves much direct contact with the professors and associate professors.
required knowledge	Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology plus topmaster portal course, or equivalent

name	**Sequence Analysis**
code	
coördinator	Prof. Dr J. Heringa
lecturers	Prof. Dr J. Heringa, Dr. J. Kleinjung, and other lecturers
ECTS	5
Time period	November/December 2004
aim	• A theoretical and practical bioinformatics course about biological sequence analysis. The course provides an introduction to the algorithmic and biological principles of sequence analysis, as well as practical implications. *Goals:* • At the end of the course, the student will be aware of the major issues, methodology and available algorithms in sequence analysis. • At the end of the course, the student will have hands-on experience in tackling biological problems in sequence analysis.
contents	*Theory*: • Dynamic programming, database searching, pairwise and multiple alignment, probabilistic methods, pattern matching, evolutionary models, and phylogeny. *Practical*: • Assignment programming own alignment software based on dynamic programming • Assignment homology searching and pattern recognition using biological and disease examples • Assignment multiple alignment of biological sequences
methodology	• 13 Lectures (2 two-hour lectures per week) • Assignment introductions • Computer practicals • Hands-on support
literature	• E-course material: http://ibivu.cs.vu.nl • Books: Arthur M. Lesk (2002) Introduction to Bioinformatics, Oxford University Press, pp. 289, ISBN (Pbk) 0 19 925196 7.
teaching	Active participation (November/December 2004).
test	Assignment results and oral or written exam (depending on number of course students)
target group	Students with Bachelor Physics, Chemistry, Mathematics, Computer Science, Biology, or Medical Natural Sciences, with a strong interest in Bioinformatics
remarks	The course is taught in English.

required knowledge	Bachelor Physics, Chemistry, Mathematics, Computer Science, Biology, Medical Natural Sciences. Some experience in programming is required.

name	**Biological Fluorescence – Interactions of Biomolecules**
code	
coördinator	Dr Y. Bollen
lecturers	Prof. Dr H. Lill, Prof. Dr T. Visser, Dr. Y. Bollen, and guests
ECTS	6
Time period	February 2005
aim	*Goals:* To introduce students into the application of various fluorescent methods to tackle biochemical problems. Students should be able to • plan and conduct experiments utilizing fluorescent techniques to tackle own questions • evaluate results on the basis of recent literature Students should know • theoretical principles and application of different fluorescence methods
contents	*Theory*: Theoretical fundaments and practical applications of (time-resolved) fluorescence will be covered. *Practical*: • laboratory work with several different fluorescent methods, including a unique one (PEFFLS) which has been developed within the department of Structural Biology • Interpretation and evaluation of results will be carried out on site by course participants, assisted by lab personnel
methodology	• Lectures • Tutorials/discussions of book material, lecture notes • Laboratory work: students work in small groups (2-3 persons) within the department's labs
literature	Reader (ca 5 €)
teaching	Active participation (February 2005)
test	Written report
target group	Students with Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology with a strong interest in the interface between these disciplines
remarks	The course is taught in the English language, and involves much direct contact with the professors and associate professors.
Required knowledge	Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology plus topmaster portal course, or equivalent

name Proteins: structures, folding and dynamics

code

coördinator Prof. Dr. S. van der Vies, Prof. Dr. N. Vermeulen

lecturers Guest lecturers

ECTS 5

Time period March 2005

aim An intensive course to acquaint the students with the most modern and effective concepts and methods for the study of proteins in action

Goals:

- To obtain knowledge and insights in the structure and the molecular mechanisms of action of proteins, in order to understand their basic and special biological functions. Special emphasis is will be given to the folding and the dynamics of proteins.

contents *Theory*

- The molecular properties of the basic structural elements of DNA, lipids and proteins, such as helices, sheets, strands, barrals etc will be discussed as well as the forces and interactions responsible for the structure, the functions and the flexibility of proteins. Special attention will be given to the complexity of the protein folding process. The basic concepts and typical applications of experimental techniques to solve macromolecular structures and to study their dynamical behaviour will be reviewed, as well as computational techniques that can be used to generate protein structures and to simulate their own dynamics and the dynamics of their ligands. A number of more specific proteins or complex protein systems will be discussed with the aim to understand, in an intergrative way, the complexity of protein-protein and protein-ligand interactions and the way the protein (complex) functions, if possible while in action.

Practical:

- In silico visualisation of selected proteins and protein-ligand interactions
- In silico construction and engineering of proteins
- In silico control analysis on the basis of earlier experimental results

methodology

- Tutorials/discussions of book material, lecture notes
- Web-courses
- Computer practical classes
- Lab-inspection work: Students follow and assist an experienced postdoc/Ph D student performing a key experiment. Data evaluation and interpretation on site.

literature

- Introduction to Protein Structure, Carl Branden en John Tooze,

1999, Garland Publishing Inc.

- E-course material
- Recent articles from Nature Structural and Molecular Biology

teaching	Active participation (March 2005)
test	Written exam
target group	Students with Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology with a strong interest in the interface between these disciplines
remarks	The course is taught in the English language, and involves much direct contact with (associate) professors.
Required knowledge	Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology plus topmaster portal course, or equivalent

name **Intracellular networks**

code

coördinator prof. Dr H.V. Westerhoff

lecturers Prof. Dr H.V. Westerhoff, Dr B.M. Bakker, Prof. Dr J. L. Snoep, and guests

ECTS 5

Time period February 2005

aim An intensive course for introduction to cell biological networks.

Goals:

- The course gives an introduction into the behavior of intracellular networks, including metabolic pathways, signal transduction chains, gene expression pathways and their hierarchical organization. Metabolic and Hierarchical Control Analysis, Biological Non Equilibrium Thermodynamics, Biological (Self-), Genetic Network Analysis, Elementary Mode Analysis, Flux (Balance Analysis) will be explained and practiced. The levels of genomics (genome, transcriptome, proteome, metabolome and function) and their interrelationships will be clarified, both theoretically and experimentally.

contents *Theory*:

- The course gives an introduction into the behavior of intracellular networks, including metabolic pathways, signal transduction chains, gene expression pathways and their hierarchical organization.
- Metabolic and Hierarchical Control Analysis, Biological Non Equilibrium Thermodynamics, Biological (Self-), Genetic Network Analysis, Elementary Mode Analysis, Flux (Balance Analysis) will be explained and practiced.
- The levels of genomics (genome, transcriptome, proteome, metabolome and function) and their interrelationships will be clarified, both theoretically and experimentally.

Practical:

- inspection experiments performing flux and metabolite measurements and subsequent regulation analysis
- inspection experiments deigning network targeted inhibitors of parasites flux analysis on the basis of a set of computer data
- control analysis on the basis of earlier experimental results

methodology

- Lectures
- Tutorials/discussions of book material, lecture notes
- Web-courses (www.siliconcell.net)
- Computer practicals
- Lab-inspection work: Students follow and assist an experienced postdoc/Ph D student performing a key experiment. Data evaluation and interpretation on site.

literature

- Reader (10 euro)
- E-course material: http://www.bio.vu.nl/hwconf/teaching/Mathbiochemie/; www.siliconcell.net

- Books: Chapters from:Understanding the Control of Metabolism (Fell, D) Portland Press; Metabolic Engineering in the Postgenomic Era (Kohlodenko & Westerhoff, Editors), Horizon Bioscience; Thermodynamics and Control of Biological Free-energy transduction (Westerhoff and Van Dam), Elsevier

teaching	Actieve participation (January 2005)
test	Written exam
target group	Students with Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology with a strong interest in the interface between these disciplines
remarks	The course is taught in the English language, and involves much direct contact with the professors and associate professors.
Required knowledge	Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology plus topmaster portal course, or equivalent

name **Self-organization and emergence of function**

code Self-organisation, emergence, function and complexity

coördinator prof. dr H.V. Westerhoff

lecturers Prof. Dr H.V. Westerhoff, Dr Ir. B. Kooi, Dr F.C. Boogerd, and guests

ECTS 3

Time period May 2005

aim An intensive course for introduction to biological self-organization

Goals:

- Appreciation and understanding of the phenomenon that nonlinearly interacting processes can lead to the generation of new properties.
- Insight that in Biology it is not only self-organization that matters, but also molecular properties (the genome sequence), perpetration (inheritance of preexisitng organization in the mother cell, and selection for functionality matter.
- Insight in examples, such as pattern formation in early development, metabolic oscillations, adaptation and robustness
- Insight in the biological funcions that may arise by self-organization in combination with the above
- Ability to construct and work with mathematical models of self-organisation

contents *Theory*:

- Stability analysis
- Far-from-equilibrium thermodynamics
- Biology of pattern formation in ealry development
- Fourier and Metabolic Control Analysis of oscillatory systems
- Biochemistry of glycolytic oscillations and their synchronization
- Biology of adaptation, induction, robustness and selection
- Dynamic energy budget theory

Practical:

- inspection experiments with synchronizing yeast glycolytic oscillaitons
- computer modelling of early development
- use of mathematica and maple for stability analysis

methodology

- Lectures
- Tutorials/discussions of book material, lecture notes
- Web-courses
- Computer practicals
- Lab- work: Experiments
- Data evaluation and interpretation on site.

literature

- Reader (10 euro)

teaching	Active participation (May 2005)
test	Written exam
target group	Students with Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology with a strong interest in the interface between these disciplines
remarks	The course is taught in the English language, and involves much direct contact with the professors and associate professors.
Required knowledge	Bachelor Physics, Chemistry, Mathematics, Biology, Medical Biology plus topmaster portal course, or equivalent