**Summer University 2016**

**Course: Green Liver Systems – Eco Friendly Water Purification**

Prof. Dr. Stephan Pflugmacher Lima

Chair: Ecological Impact Research & Ecotoxicology

1. Week  

<table>
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<tr>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
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<tr>
<td>09:00 - 10:30</td>
<td><strong>Introduction/Campus Tour</strong></td>
<td>Session 2: Environmental Disasters</td>
<td>Session 5: Aquatic Macrophytes</td>
<td>Session 7: Green Liver Systems China/Korea</td>
<td>Berlin/Culture</td>
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<td>11:00 - 12:30</td>
<td><strong>Campus Rally</strong></td>
<td>Session 3: Basics in Ecotoxicology I</td>
<td>Session 6: Phytoremediation</td>
<td>Session 8: Green Liver Systems Brasil/Bolivia</td>
<td>Berlin/Culture</td>
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<td>14:00 - 16:00</td>
<td>Session 1: Introduction to the GLS course</td>
<td>Session 4: Basics in Ecotoxicology II</td>
<td>Berlin/Culture</td>
<td>Cocktail and Discussion Time (Piano Lake, Potsdamer Platz)</td>
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<td>16:30 - 21:00</td>
<td>Berlin/Culture</td>
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**Key Reading for the Day**

- Sandermann et al. (1994)  
- Pflugmacher et al. (2015): Physiological response of the three macrophytes to a time dependent exposure of cell-free crude extract containing three microcystins from cyanobacterial blooms of Lake Amatitlan, Guatemala. Aquatic Toxicology, 163: 130-139
- Romero-Oliva et al. (2015): Antioxidative response of the three macrophytes to a time dependent exposure of cell-free crude extract containing three microcystins from cyanobacterial blooms of Lake Amatitlan, Guatemala. Aquatic Toxicology, 163: 130-139

**Session 1 Introduction to the Green Liver Systems course**

Welcome address, get to know each other, CSI Berlin - visit the laboratories of the Department, introduction of the time table for the course, hand over of the course material.

**Lecture: Water - a highly necessary resource**

What is „water“, the chemical point of view, water crisis in a global perspective, political water programs, facts about safe water, drinking water, climate change effects, how we use water, sustainable water use, water from an extraterrestrial point of view.

**Session 2 Environmental Disasters**

The big oil spills of the world, Minamata and mercury, red river Rhein, the Brasilian heavy metal diseaster 2015, the non-visible diseasters.
Session 3 Basics in Ecotoxicology I
History of ecotoxicology, biomagnification-bioaccumulation-bioconcentration, biotransformation, phase I cytochrome P-450, phase II glutathione S-transferases, phase III cellular localisation, excretion.

Session 4 Basics in Ecotoxicology II
Reactive oxidative species, where do they come from?, Oxidative stress the damages (lipidperoxidation, proteinoxidation, DNA damage), antioxidative defense, non-enzymatic based (tocopherols, ascorbate, glutathione, liponic acid), enzymatic based (superoxid dismutase, catalase, peroxidase)

Session 5 Aquatic macrophytes
Introduction to the world of aquatic plants in freshwater and marine systems, higher plants – macroalgae - microalgae

Session 6 Phytoremediation
What is phytoremediation, history of using plants for environmental clean up, wetlands and constructed wetlands, the pro’s and con’s of wetland systems, important wetlands in the world, performance of wetlands in clean up xenobiotics.

Session 7 Green Liver Systems (PR China/Korea)
What is a Green Liver System, underlaying concept, biochemical background of Green Liver Systems, the Green Liver System in China, building phase, operation phase, Green Liver System in South Korea, the planning.

Session 8 Green Liver Systems (Brasil/Bolivia)
Green Liver System in Brasil, planning, construction, operation, brasilian way of aquaculture, showing the Film „Green Liver System in Brasil“, Green Liver Systems in semiaride areas. Green Liver System in Bolivia, working with children and Green Liver Systems, environmental education and Green Liver Systems including our first comic film on Green Liver Systems.

Cocktail and Discussion Time
We all will meet at Potsdamer Platz at the Piano lake. Drinks on own expenses.
# 2. Week 01. August – 05. August 2016

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<td>09:00-10:30</td>
<td><strong>Monday Morning Wake Up Brunch</strong></td>
<td><strong>Session 11:</strong> Planning our GL Systems I</td>
<td><strong>Session 14:</strong> Hands On Construction</td>
<td><strong>Excursion Water Work Potsdam</strong></td>
<td>Berlin/Culture</td>
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<td>11:00-12:30</td>
<td><strong>Session 9:</strong> Students Lectures</td>
<td><strong>Session 12:</strong> Planning our GL Systems II</td>
<td><strong>Session 15:</strong> Hands On Construction</td>
<td><strong>Excursion Water Work Potsdam</strong></td>
<td>Berlin/Culture</td>
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<td>14:00-16:00</td>
<td><strong>Session 10:</strong> Students Lectures</td>
<td><strong>Session 13:</strong> Hands On Construction</td>
<td>Berlin/Culture</td>
<td><strong>Excursion Visit at Biosphäre Potsdam</strong></td>
<td>Berlin/Culture</td>
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<td>16:30-21:00</td>
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### Key Reading for the Day

### Monday Morning Wake Up Brunch
For each brunch food, coffee, tea, juice and water will be provided by my Department.

### Session 9 and 10  Student Lectures
Every participant has to prepare a 5 min talk on the water situation of their respective country. Showing the current situation and the main problems in their respective country.

### Session 11 and 12  Planning our Green Liver System
Participants will be divided into two to three groups. Every group will start planning their own Green Liver System.

### Session 13, 14 and 15  Hands On Construction
With material provided from the Department full functioning Green Liver Systems will be constructed in the laboratory.

### Excursion Day
Visit to the Water work Potsdam, see and learn how drinking water will be made, visit the Biosphäre Potsdam.
### Timetable

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<td>09:00 - 10:30</td>
<td><strong>Monday Morning Wake Up Brunch</strong></td>
<td>Session 18: Introduction to Water Analysis</td>
<td>Session 21: Hands On Experiment I Remediation of Diclofenac</td>
<td>Session 23: Hands On Experiment I Remediation of Diclofenac</td>
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<td>14:00 - 16:00</td>
<td>Session 17: Guest Lecture Prof. Dr. S. Kim (KIST Europe)</td>
<td>Session 20: Discussion of the Key Readings 1. and 2. Week</td>
<td>Berlin/Culture</td>
<td>Cocktail and Discussion Time (Piano Lake, Potsdamer Platz)</td>
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<td>16:30 - 21:00</td>
<td>Get together with our Guest at the Hofbräuhaus Berlin (Alexanderplatz)</td>
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#### Key Reading for the Day

### Monday Morning Wake Up Bruch
For each brunch food, coffee, tea, juice and water will be provided by my Department.

### Session 16
Summing up the Excursion Day, What did we learn?, how can we include this new knowledge in our Green Liver Systems

### Session 17
Guest Lecture of Prof. Dr. Sanghun Kim (Korean Institute of Science & Technology, Europe). Sanghun will talk about Risk Assessment in Aquatic Ecosystems.

### Get together with Prof. Kim
Time for discussions good talks and great bavarian beer and food at the Hofbräuhaus Berlin (Alexanderplatz). Own expenses.

### Session 18 Introduction to Water Analysis
Sample preparation, modern HPLC analysis, Mass Spectrometry Analysis, key substances, analytical problems

### Session 19 Hands On Experiment
Starting the Experiment I: Remediation of Diclofenac, a painkiller in our systems, preparation of water samples for LC-MSMS analysis
Session 20 Discussion on Key Readings
Let’s talk about the key readings, pro’s and con’s of the articles, what we can learn from the readings.

Session 21, 22, 23 and 24
Experiment I: Remediation of Diclofenac, a painkiller in our systems, preparation of water samples for LC-MSMS analysis

Cocktail and Discussion Time
We all meet at a nice Open Air Bar directly at the Piano Lake at Potsdamer Platz. Introduction of the city lake and the Green Liver System partially included there.
Monday Morning Wake Up Brunch
For each brunch food, coffee, tea, juice and water will be provided by my Department.

Session 25 and 26  Assessment of the Experiment
Assessment of the LC-MSMS data sets for the remediation of Diclofenac from our systems

Session 27, 28 and 29 Improving our Systems
Data discussion, every group has to present their data to the other participants, comparing the performance of the different systems, evaluation of the efficiency

Session 30 Special Green Liver Systems
Green Liver Systems for Zoological Gardens, special requirements

Session 31 Special Green Liver Systems
Space... the final frontier... these are the voyages of the Starship Enterprise. To boldly go where no one has gone before... BUT  how about fresh good tasty water???

Session 32 Special Green Liver Systems
Green Liver on Wheels. The first mobile version of the Green Liver Systems.

Session 33  Round Table Discussion
Summing Up the Green Liver System Course, Group Photo Time

Fare Well Green Liver System Pizza Party
Different kind of Pizza and softdrinks will be provided by my Department for all participant. Handing over the Green Liver Team T-Shirts for the participants.
Our Team T-Shirt for every participant free of charge 😊 provided by my Department
Student Assessment

This will be done taking the student presentation into account and the activity during the course, as well as the active role in the round table discussion.