Capacity Building and Development (CBD) in Oceanography Through Regional Graduate Networks in Oceanography

Why do I want to offer a CBD-course through my institution?

Can it be embedded into the needs of my university (e.g. local graduate /postgraduate program)? Can it be counted for the partial fulfillment of a degree?

Do we want to offer it to our own students only or possibly also to students from other universities (outreach, prestige)?

Can we offer topics, knowledge, study sites, methods, etc. that are unique for the field of oceanography and attractive for students in the field?

Do we have the academic capacity (team of experts or access to them) to launch such an activity and can we count on the willingness of our colleagues to contribute?

In which form shall we offer the CBD-course, as a block course at a suitable location outside the university (intense focusing) or as a regular curriculum course outside of the teaching semester?

Do we have the intention to develop the course into a sustainable CBD-program?

Can we offer suitable course facilities to house and work with a group of students?

How do we evaluate and follow up on the success of our activities?

How can we assure funding for a number of years?
ECODIM as an Example: Regional focus – international outlook and collaboration

Between 2000 and 2010 more than 90 students and 10 young investigators from 10 South- and North-American countries participated in ECODIM courses.

At UdeC, ECODIM courses are part of an ongoing graduate / postgraduate program at the Austral Summer Institute at the University of Concepción. The RGNO was established in 1997 by José Stuardo. All courses are part of a regional graduate school in Oceanography with an international outlook. The institution that offers the courses are supported by foundations, government research agencies, instrument and supply companies and the international research community. ECODIM (Ecology and Diversity of marine Microorganisms, a 3-4 week course, accepting 15 students per course, offered every second year in January) became part of the Austral Summer Institute in 2000. ECODIM reference: http://www.microeco.uzh.ch/chile/chile.html
Course teaching philosophy

• Ideal learning opportunities: a combination of field experiences and laboratory experimentation

• Teaching across borders of scientific fields

• Building an appreciation and creating a profound understanding of the basic scientific principles of the “other” disciplines

• Illustrating background knowledge with field experiences and research results

• Small research projects with emphasis on discovery and research-driven teaching
Course structure (ECODIM model)

The course comprises:

- **Lectures** in the morning,
- **Laboratory work** in the afternoon,
- **Colloquia** and **modeling exercises** on the computer in the evening,
- **Discussions** and sessions on particular course subjects are offered during the course and
- **Research themes** are discussed during the **minisymposia** on Saturday mornings.

On **field trips** we point out
- physico-chemical characteristics of microbial habitats,
- collect microbes and try to enrich and isolate them in the laboratory.

The **laboratory work** is designed to educate students about current techniques and to encourage independent research.

It is divided into two parts
- In part 1, we train microbiological and molecular techniques and learn about concepts
- Part 2 is investigative, i.e. we would like to discover new microbes and understand their activities within complex communities. Here, the students carry out investigations in groups with faculty assistance and independently.
- A poster presentation is the envisioned research product.
Field investigations

- Research guided field experience as the starting point for every microbial oceanography course
- Collaboration with local researchers, with those from different countries and with a number of internationally leading experts
- Integrated investigations at selected sites
- Teaching the students how to do multidisciplinary microbial oceanography in the field and in the lab

Infrastructure for field investigations

- Sea-going boat with sediment coring and hydro cast
- Field-tested methodology and instrumentation
- Equipment needs to be taken to the field and / or be set up at a base station
What we have learned from past ECODIM experiences and what works well

General concept
• The basic structure of the course is successful and it has improved with each course experience.

Minisymposia
• are a means of introducing the students to front research.

Research projects
• are activities during which the student gets practical experience and where he/she is learning by doing.
• molecular techniques were introduced into the course with the support of instrument manufacturers and reagent supply companies.

Colloquia
• the student is trained in how to search, evaluate and select the literature, which is most important for his/her research (self-learning).
• time spent on colloquia with student presentations improves scientific presentation and language skills.
• workshop-type discussions about new technical developments and limitations of certain techniques (e.g. DNA sequencing) help students to chose proper experimental approaches for their own research.
• familiarity with computer handling, which often still needs individual training, is a prerequisite for model building and access to databases.

Individual studies
• independent study time is integrated into the program for reading and preparing discussions about key papers.
• reading-assignments and exam papers are offered by the staff or freely chosen by the student. Advice assures that the time is spent on analyzing and presenting relevant publications.
Lectures
• include discussions and student activity,
• introduce basic microbiological concepts and knowledge and prepare the ground for focused research work,
• give context and overview before spiraling down into details.
• Lecture slides are made available on the course intranet for self-study and repetition

Field trips
• expose the student to difficulties when working under harsh conditions
• train decision-making at the spot
• emphasize the importance of detailed preparation and considering options
Quality criteria (ECODIM experience)

The course needs to be recognized by the international research community, and it has to have an excellent reputation

**Instructors**
- excellent instructors must feel attracted to support and contribute to the course
- all instructors will be chosen for their scientific as well as their didactic abilities
- all instructors need to receive excellent ratings from the course participants

**Field experience**
- the field trips are discovery and research-driven introductions to the course and remain a highly rated aspect of the course
- the field trips and the course can count on the guidance of a number of knowledgeable investigators

**Research aspect**
- well-prepared projects are carried out with expert methodology
- there is enough time permitted to work on research projects
ECODIM quality criteria, cont.

**Infrastructure and accommodations at course site**

- suitable local infrastructure and commitment by the staff
- room and board accommodations to keep student group together
- suitable field sites for studies
- the lab and the accommodations need to allow for focused scientific work and social interaction
- the chemical analytical, microbiological and molecular biochemical infrastructure is adequate for course work with 15-20 students
- rooms for lectures and seminars equipped with audiovisuals
- computers and computer network for online training and access to databases
- the symposia are highly attractive to students as well as to local and national scientists
- the course organization (logistics of the field trip, housing, lab use) receive the highest possible rating
Example: ECODIM - Ecology and Diversity of Marine Microorganisms
(Section: microbial Oceanography)

http://www.microeco.uzh.ch/chile/chile.html

ECODIM marine microbiology (mmb) graduate / postgraduate courses are part of the Austral Summer School at the University of Concepción, Chile. ECODIM was established in 2000 and is offered every second year

- A 3 week mind-opening training period
- Emphasis on capacity building through research-guided learning
- Attraction: Oxygen Minimum Zones in the upwelling region off the coasts of Chile and Peru
- Course features
  - Sampling trips (field experiences)
  - Lectures (syllabus that integrates various science fields)
  - Instructed experiments (methodology, instrumentation)
  - Computer supported exercises and data base searches (concepts, model design)
  - Group research projects (discoveries, hands-on instruction based on field observations)
  - Mini-symposia (outreach and front research, on Saturdays)
  - Student reporting (oral presentations, poster designs)
Goals and purpose of ECODIM courses

• To provide an overview of the many facets of the field of microbial oceanography by bringing together various themes of a number of environmental sciences

• To cross borders between physics, chemistry, geology and biology applied to marine ecosystems

• To initiate contacts between scientific fields, which are not usually combined

• To learn about microbiology with a geochemical and environmental emphasis
Future directions of ECODIM courses

• participating in the international microbial oceanography research network

• maintaining it attractive for world-class investigators to be interested in participating and in offering lectures and / or supporting course groups on field investigations

• acquiring the support of established oceanographers from all over the world to introduce the course students to interesting sites in their countries

• basing the course on teams of international instructors with rotating participation

• integrating former course participants
Summary

WHAT THE COURSE ATTEMPTS TO OFFER

• An introduction to microbial diversity and ecology
• A discussion on some molecular techniques and on how they are related to cultivation-based approaches
• An examination of the strengths and limitations of approaches used to describe diversity, e.g.
  • Why molecular techniques do not replace cultivation but complement it
  • How cultivation attempts can be made successful
• Investigations of interesting microbial ecosystems on field trips
• An emphasis on the marine environment and other microbial ecosystems present in the area

WHAT THE COURSE SHOULD LEAD TO

• Make the student aware of the diversity in metabolic activities and of interactions between microbes and between microbes, animals and plants
• Give the student insights into the history of life on earth and on approaches to discovering life on other planets
• Make the student respect the microbial biosphere as the earth's life support system
• Make the student understand microbial diversity as a provider of an array of new products and processes
• Initiate new ways to discover infectious causes of diseases not previously recognized as microbial in origin
• Open up contacts between scientific fields which are not usually combined
WHAT WE INTEND TO TEACH

• How microbes behave in their natural environments
• The role of microbes in global geochemical cycles
• Some of the more unusual cultivation techniques as well as cultivation of interesting microorganisms
• Microbial diversity as a critical aspect of future environmental and medical research
• Microbial diversity as the basis for emergence of infectious diseases and increasing antibiotic resistance
• Experience in "frontier" research

WHAT THE COURSE DOES NOT DO

• Cover all microorganisms
• Cover all techniques currently being used in diversity studies; we will focus on cultivation
• Offer exercises with known outcomes; we intend to investigate and discover

HOW THE COURSE IS ORGANIZED

• Lectures (morning), Lab exercises (afternoon), Workshops (evening), Group reports (end of course)
• Field trips (whenever appropriate)
• Minisymposia (Saturday morning)
• Research work in groups of 2 to 3 students on a specific project
• Student input is important
Sponsors of ECODIM and other Summer School Courses of the Austral Summer Institute

Additional support from:
- Reichmann (Zeiss Microscopes)
- Andes Import
- Arquimed
- GeneXpress
- UNESCO-IOC