

**OCN 310L: Global Environmental Change Laboratory
(cross-listed as MET 310L and OEST 310L)**

Marine Science Building, Room 307/314, Tue 1:30–4:00 pm

Instructor: Richard E. Zeebe

TA: Saulo Soares, MSB 213A, Tel. 956-5294, Email: saulo@hawaii.edu

Textbook: Consider a spherical cow: A course in environmental problem solving, John Harte, University Science Books, Sausalito, CA, 1988. ISBN: 0-935702-58-X.

Grading:

Weekly homework assignments: 30%

Homework presentation and class participation: 40%

Draft, paper and oral presentation: 30%

No midterm! No final!

Rules:

In fairness to other students, draft or paper turned in 1 and 2 days late will receive a grade corresponding to 2/3 and 1/3 of the points scored, respectively. After 2 days, zero credit will be given. Homework not turned in before class receives 0 points. These rules apply unless there is a *documented* reason such as medical emergency or funeral.

In this class you will develop and improve skills in working out strategies and ideas how to quantitatively solve problems. The topics will focus on Earth's environment. Your challenge will be to develop concepts and approaches to various problems and finally provide useful solutions to them (calculating sophisticated, highly accurate answers will not be the goal, rather useful approaches and reasonable values will be required). This is sometimes not a trivial task and you should **anticipate to spend a considerable amount of time on your homework**, but – as the famous physicist Richard Feynman has put it – you will have "the pleasure of finding things out"!

If necessary, contact Saulo regarding your homework – but only after in-depth consideration of the problem and with a preliminary idea or a precise question.

The first part of the class will be concerned with problems and exercises of the textbook. Every week homework will be assigned and turned in before class the week after. The homework will be discussed in class and every week some of you will present their solutions to the other students (**bring an extra copy of your homework to every class!**). The presentation will rotate and at the end of the semester each student will have presented approximately the same number of exercises.

The second part of the class will be concerned with developing and using numerical tools for quantitative problem solving. The scientific topic will focus on phosphorus cycling in the ocean. You will develop a numerical algorithm (in groups of two) to solve the equations of a box model of the ocean's phosphorus cycle (Toggweiler, 1999). The software used for this application will be MATLAB (**bring a diskette or memory key to every class in order to save your files!**). After development of the base model, you will choose a project which will serve as the subject of your paper and oral presentation. A typical project will require changes to the existing numerical code in order to perform a sensitivity study or tackle a related/advanced problem.

Tentative Schedule

Aug 26

Introduction
Chapter I.1–I.7
Homework (due Sep 02):
 Related exercises, to be assigned
 Read p. 21–33, Chapter II.1–II.4

Sep 02

Chapter II.1–II.4
Homework (due Sep 09):
 Related exercises, to be assigned
 Read p. 34–44, Chapter II.5–II.7

Sep 09

Chapter II.5–II.7
Homework (due Sep 16):
 Related exercises, to be assigned
 Read p. 95–108, Chapter IIC (II.19–II.20)

Sep 16

Introduction to chemical equilibria

Chapter II.19–II.20

Homework (due Sep 23):

Related exercises, to be assigned

Read p. 111–113, 138–149, Chapter (II.22, III.4)

Sep 23

Non-steady state box models and carbonate chemistry

Chapter II.22, III.4

Homework (due Sep 30):

Related exercises, to be assigned

Read MATLAB Intro

Sep 30

Introduction to MATLAB

Homework (due Oct 07):

Solve analytically $dy/dt = \lambda y$, $y(0) = y_0$

Oct 07

Solve numerically $dy/dt = \lambda y$, $y(0) = y_0$

Develop routines for base model (PO₄ in 3-box model)

Homework:

Work on model/Read project description

Oct 14

Develop routines for base model (PO₄ in 3-box model)

Discussion/assignment of projects

Homework:

Work on model/draft paper

Oct 21

Finalize routines for base model (PO₄ in 3-box model)

Model experiments

Homework:

Work on model/draft paper

Oct 28

Model experiments

Work on draft paper

Homework:

Draft paper

Nov 04: Election Day

Nov 11: Veterans' Day

Thursday, Nov 13, 03:00 pm: Draft paper due for review
→ Mailbox, MSB 205

Nov 18

Discussion of reviewed draft paper

Work on model/final paper in class

Homework:

Work on model/final paper

Prepare oral presentation

Tuesday, Nov 25, 01:30 pm: Final paper due

Nov 25

Oral presentations

Homework (due Dec 02):

Read p. 45–58, Chapter II.8–II.10

Dec 02

Chapter II.8–II.10

Homework (due Dec 09):

Related exercises, to be assigned

Dec 09

Homework Presentation

Chapter II.8–II.10

Student Learning Outcomes

Upon completion of this course students should:

- be able to solve basic problems in Environmental Sciences using analytical and numerical techniques.
- be able to use and apply an advanced computational tool (MATLAB).
- have improved oral and written communication skills.