



IB 159: The Living Planet: Impact of the Biosphere on the Earth System
(3 units)
Course Summary and Syllabus
Fall Semester, 2011

Basic information

Instructors: Cindy V. Looy, Ivo A.P. Duijnste
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(Please include IB159 in subject line)
Instructor office hours: Wednesday 10:30-12:30pm in 4101 VLSB

GSI: Renske Kirchholtes
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GSI office hours: Tuesday 9:00-10:00am in 3019 VLSB
Thursday 8:30-9:30am in 3019 VLSB

When you are enrolled in this course, a tab for this course will be added to your personal bSpace account. Here you will find this syllabus and a forum, where you can share your ideas and thoughts with fellow students.

Course description

Prerequisites

Biology 1B or consent of instructor.

Overview of the course

Planet Earth is a complex, dynamic system in which the interplay between its components atmosphere, hydrosphere/cryosphere and lithosphere largely determines the conditions on the planet's outside that we inhabit. The different components exchange matter and energy through global element cycles, volcanism, weathering, evaporation, precipitation, radiation, absorption, etc.; thus continuously changing each other's

properties. Also within the components energy and matter are perpetually cycled. Obviously, the changing physicochemical conditions of the abiotic environment have a profound impact on life on earth. Less generally known is the vast influence life continuously asserts on the abiotic components of the earth system; in fact the biosphere itself is an important Earth system component. Interestingly, life – with its evolving species – forms a complex adaptive system. Therefore, with the addition of an adaptive, evolving component, some argue the earth system itself may have gained adaptive properties. We will discuss pros and cons of such Gaia-like views.

During our course we will briefly touch on General Systems Theory and Cybernetics. However, the focus will be on the ever-changing state of System Earth (especially in terms of global climate) throughout our planet's geologic history; in particular the effect the evolving biosphere has had on the Earth system over the last 3.5 billion years, and vice versa. We will cover a wide range of temporal and spatial scales (from sub-decadal to hundreds of millions of years, and from regional to global and beyond), and discover that variations in the Earth's state are governed by different sets of processes on different spatial and temporal scales. In the last part of the course we will focus on what some consider the recent emergence of yet another component in the earth system: the anthroposphere. In the current age of human-induced climate change we cannot neglect to explore as to what extent one particular species of bipedal mammal may affect the earth system.

Methods of instruction

Two hours of lecture and two-hour discussion sections (or assignments) per week.

Primary or required books/readings for the course

The Earth System, Third Edition (2010), by Kump, Kasting & Crane; Prentice Hall/Pearson.
ISBN10: 0321597796
ISBN13: 9780321597793

Course requirements

Exams and quizzes

There will be three exams, two midterms and one final. These are closed book exams, with essay as well as multiple choice questions. The exam will be based on the things you learned during lecture but also on material covered during the discussions.

Time and location **midterm I**: Monday, October 10, 2011 in Wheeler 130, 2-4pm

Time and location **midterm II**: Monday, November 7, 2011 in Wheeler 130, 2-4pm

Time and location **final**: Thursday, December 15, 2011, 3-6pm Location to be announced.

Assignments

Students will have to prepare for the discussion section by reading the materials and coming up with one question for each article they read. These questions have to be electronically submitted before the deadline via the bSpace dropbox. Also, students will be required to hand in their assignments after each discussion section via bSpace. This will count towards your grade. For discussion everyone will have to prepare a short presentation about an assigned paper. The details of these assignments are outlined in another document named Discussion Guidelines which can be found on bSpace under Resources – Course information.

Policies

Grading procedures

The course grade is based on the following scheme:

Midterm I: 25%

Midterm II: 25%

Final: 25%

Participation in discussion sessions (including handing in assignments): 25%

The class can be taken for a grade and as pass/no pass. A C+ is required to pass this class. The grades will not be curved. Written grade appeals are accepted in a time window starting three days after the initial grade has been assigned until ten days after. Before or after this period appeals will not be considered. Students who wish to review their exam should email the instructor.

Attendance and class participation

Attendance is recommended for lectures and required for discussion sections. Part of your course grade will be based on your participation during section. Being prepared, attentive listening and completion of in-class work is important.

If you must be absent due to a family emergency or illness, please contact the GSI as soon as possible at renske.kirchholtes@berkeley.edu.

Classroom etiquette

Please, turn off your cell phone completely before entering the classroom.

Missed exams and missed or late assignments

You are expected to take all exams at their scheduled date and time. How we deal with missed exams and missed or late assignment will be decided on an individual basis by the instructor. If you know you are going to miss an exam, contact the instructor in advance. When you have missed an exam or assignment it is **up to you** to contact the instructor about this.

Reporting illness and family emergencies

If illness or a family emergency does prevent you from attending class, attending section or making an exam, we will require written proof of the situation.

Extra credit opportunities

No extra credit opportunities are offered for this class.

Permissible and impermissible collaboration & academic honesty

Students will be expected to produce their own work product and utilize appropriate references when required. If you are unsure or uncomfortable about your skills in this area, please contact the Student Learning Center for some assistance. Academic honesty violations are grounds for an F in this course.

Schedule

Calendar of topics and readings

PART I

INTRODUCTION & THE EARTH SYSTEM COMPONENTS

wk 1

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|-------------|-----------|---|
| 08-29 | L1 | Feedbacks and forcings: An introduction to Systems Science and Cybernetics |
| 08-29 | L2 | Mother Earth: Earth as a Complex Adaptive System |
| 08-30/09-01 | D1 | The Gaia discussion |

wk 2

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|-------------|------------|--|
| 09-05 | | LABOR DAY |
| 09-06/09-08 | D2* | How we know the things we know about paleo? |

wk 3

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|-------------|-----------|--|
| 09-12 | L3 | Here comes the sun: Changing solar forcing and Earth's radiation budget |
| 09-12 | L4 | Air: Atmospheric properties and circulation – global energy budget |
| 09-13/09-15 | D3 | Water in the atmosphere discussion: greenhouse gas or cooling agent? |

wk 4

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|-------------|-----------|--|
| 09-19 | L5 | Water: Ocean circulation and heat transport |
| 09-19 | L6 | Ice: Waning and waxing of ice sheets and albedo feedback |
| 09-20/09-22 | D4 | Ocean Planet Straight or On The Rocks? Earth and its Ice Sheets |

wk 5

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|-------------|-----------|--|
| 09-26 | L7 | Rock: Weathering, volcanism and the rock cycle |
| 09-26 | L8 | Life: The ever evolving biosphere |
| 09-27/09-29 | D5 | Origin of Life Discussion: Are we all Martians? |

COMPONENT INTERACTIONS, GLOBAL CYCLES AND THEIR IMPACT ON LIFE

wk 6

- 10-03 **L9** **Changing phases:** The water cycles
- 10-03 **L10** **Recycling of the elements I:** Nutrients
- 10-04/10-06 **Review sessions**

wk 7

- 10-10 **MIDTERM 1** on Lecture 1–8 (so 9–10 not yet!)+ associated book chapters
- 10-11/10-13 **D6*** **The Hollywood Perspective**

PART II

wk 8

- 10-17 **L11** **Recycling of the elements II:** Organic Carbon Cycle
- 10-17 **L12** **Recycling of the elements III:** Inorganic Carbon Cycle
- 10-18/10-20 **D7** **Major disturbances in the carbon cycle in the past**

IMPACT OF LIFE ON THE EARTH SYSTEM: EXAMPLES

wk 9

- 10-24 **L13** **Early biogenic heating?** Archean methanogens under a pink sky (3500 Mya)
- 10-24 **L14** **Biogenic cooling:** Oxygenic photosynthesis & the rise of oxygen & ozone
- 10-25/10-27 **D8** **Biota shaping a young planet's atmosphere**

wk 10

- 10-31 **L15** **Land plant conquests:** soils, weathering and intensified biological pump
- 10-31 **L16** **Cooling coal swamps:** carbon burial and the Permo-Carboniferous glaciations
- 11-01/11-03 **Review sessions**

wk 11

- 11-07 **MIDTERM 2** on Lecture 9–16 + associated book chapters
- 11-08/11-10 **D9*** **Guest Lecture & discussion by prof. Ellen Currano:** Life at the Paleocene-Eocene Thermal Maximum

PART III

CLIMATE CHANGE AND VARIABILITY ON VARIOUS SCALES AND BIOTIC RESPONSE

wk 12

- 11-14 **L17** **Snowball Earth:** How Earth froze over in the Neoproterozoic (750-600 Mya)
- 11-14 **L18** **Cenozoic:** Hot methane burps and a long-lasting cooling trend (65-2 Mya)

11-15/11-17 **D10 Biotic telltales of climates in the past:** proxies or problems?

wk 13

11-21 **L19 Ice Ages:** Milankovitch and the Pleistocene Glaciations (2600-12 kya)

11-21 **L20 Microscale variations:** Medieval Warm, Little Ice Age & El Niños (0.6-0 kya)

11-22/11-24 *THANKSGIVING break*

THE NEW COMPONENT: THE ANTHROPOSPHERE

wk 14

11-28 **L21 Dawn of the Anthropocene:** Human impact on the biosphere

11-28 **L22 Human-induced climate change:** Effects on Geological and Human scales

11-29/12-01 **D11 Dealing with scientific uncertainty:** the tension between climate science, public discourse and policy makers

wk 15

12-05 – 12-09 **RRR week**

wk 16

12-15 **FINAL EXAM on L17–L22 + associated book chapters (3–6PM)**

READING SCHEDULE from KUMP ET AL.'S "THE EARTH SYSTEM, 3RD EDITION"

In this textbook, there is more emphasis on the abiotic than the biotic aspects of the Earth System; both now and in the geologic past. We will use it to provide the earth science backbone for our lectures and discussion sections, on top of which we will add the biotic perspectives.

PART I

INTRODUCTION & THE EARTH SYSTEM COMPONENTS

Aug. 29	<ul style="list-style-type: none">• Lecture (1) <i>CH2 p21-33</i>• Lecture (2) <i>CH1 p18-19</i>	wk 1
Sep. 12	<ul style="list-style-type: none">• Lecture (3) <i>CH3 p36-55</i>• Lecture (4) <i>CH4 p57-70, CH10 p197-199</i>	wk 3
Sep. 19	<ul style="list-style-type: none">• Lecture (5) <i>CH5 p84-91, p96-106</i>• Lecture (6) <i>CH6 p108-120</i>	wk 4
Sep. 26	<ul style="list-style-type: none">• Lecture (7) <i>CH7 p122-146</i>• Lecture (8) <i>CH10 p199-208, if necessary: CH9 p176-188, CH13 p255-269</i>	wk 5

COMPONENT INTERACTIONS, GLOBAL CYCLES AND THEIR IMPACT ON LIFE

Oct. 03	<ul style="list-style-type: none">• Lecture (9) <i>CH4 p70-82</i>• Lecture (10) <i>CH8 p170-173</i>	wk 6
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PART II

Oct. 17	<ul style="list-style-type: none">• Lecture (11) <i>CH8 p149-162</i>• Lecture (12) <i>CH8 p162-169</i>	wk 8
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IMPACT OF LIFE ON THE EARTH SYSTEM: EXAMPLES

Oct. 24	<ul style="list-style-type: none">• Lecture (13) <i>CH12 p233-239</i>• Lecture (14) <i>CH11 p210-224</i>	wk 9
Oct. 31	<ul style="list-style-type: none">• Lecture (15) & (16) <i>CH11 p224-231</i>	wk 10

PART III

CLIMATE CHANGE AND VARIABILITY ON VARIOUS SCALES AND BIOTIC RESPONSE

Nov. 14	<ul style="list-style-type: none">• Lecture (17) <i>CH12 p240-247</i>• Lecture (18) <i>CH12 p248-252</i>	wk 12
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Nov. 21	<ul style="list-style-type: none">• Lecture (19) <i>CH14 p272-293</i>• Lecture (20) <i>CH5 p92-96, CH15 p295-301, CH19 p379-381</i>	wk 13
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THE NEW COMPONENT: THE ANTHROPOSPHERE

Nov.28	<ul style="list-style-type: none">• Lecture (21) <i>CH18 p361-376</i>• Lecture (22) <i>CH15 p301-318, CH16 p321-338</i>	wk 14
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Firm dates for exams

As mentioned earlier in this syllabus, the first midterm will take place on Monday, October 10th, 2011 in Wheeler 130 2-4pm. The second midterm is scheduled for November 7th, 2011 in Wheeler 130 2-4pm. And the final will be on Thursday, December 15th, 2011 at 3-6pm location to be determined.

Dates for special events

On Monday September 19th and on Thursday November 10th there will be IB seminars relevant to this class. Students will not be tested on the materials covered during these seminars. However, we do recommend that students attend these seminars. All IB seminars are held in VLSB 2040 from 4-5pm.

Last day to withdraw from the course

The last to drop this course without notation on transcript is **Friday, September 23th 2011**. For details, see: <http://registrar.berkeley.edu/adddrop.html>

Statement on accommodation

Students who require accommodation for medical, religious or other reasons should contact the instructor before the start of the lecture series. We will be happy to accommodate students with disabilities. We do however require a letter from the Disabled Students' Program.

Disclaimer

This syllabus is subject to change.

This syllabus is your handbook for the course. You are responsible for knowing and understanding all the information in it. **Do not lose it!** Not knowing the requirements does not excuse you from fulfilling them.