

Symbiosis

Fall 2005

Sponsor: Erik V. Thuesen, x6584, Lab I 3065, thuesene@evergreen.edu

Lab Aide: Kiri Kreamer, x5162, Lab 1 3060, kirikreamer@gmail.com

Enrollment: 25

Prerequisites: A minimum of one year of college-level chemistry with lab and course work in either botany, microbiology, mycology or zoology; one quarter of organic chemistry recommended.

Signature required: No

Credits: 16 upper division science

Weekly Schedule

Mon	Tues	Wed	Fri
8:30-11:00 Lecture (C1105)	8:30-17:00 Lab (Lab1 3046)	11:00-13:00 Lecture/Presentations (LH2)	8:30-12:30 Lab (Lab1 3046)
13:00-15:00 Seminar (B3109)			9:00-11:00 Presentations (D3109)
			13:00-15:00 Workshop (CAL)

Text books

Symbiosis: an introduction to biological associations by Surindar Paracer & Vernon Ahmadjian
Oxford University Press, 2000. ISBN: 0195118073 (pbk)

Symbiotic interactions by A.E. Douglas. Oxford University Press, 1994. ISBN: 0198542941

Symbiotic planet: a new look at evolution by Lynn Margulis. Basic Books, 2000. (#0465072720)

Parasite Rex by Carl Zimmer. Free Press, 2001. ISBN: 074320011X

Other readings on reserve in the Library (*pdf file available)

Dunlap, P. V. & M. McFall-Ngai (1987). Initiation and control of the bioluminescent symbiosis between *Photobacterium leiognathi* and leiognathid fish. *Annals of the N.Y. Acad. of Sciences*. 503: 269-283.

Fisher, C. R. (1990). Chemoautotrophic and methanotrophic symbioses in marine invertebrates. *Reviews in Aquatic Sciences*. 2: 399-436.

Hölldobler, B. (1971) Communication between ants and their guests, in Gould and Gould, eds., (1989) *Life at the edge*. W.H. Freeman.

*Poulin, R. & A.S. Grutter (1996) Cleaning symbioses - Proximate and adaptive explanations. *BioScience*, 46: 512-517.

Roberts, L.S. & Janovy, J. (2000) *Foundations of Parasitology*. WC Brown

Smith, D.C. & Douglas, A. E. (1986). *The biology of symbiosis*. Edward Arnold

Wilson, E. O. (1975) Slavery in ants, in Gould and Gould, eds., (1989) *Life at the edge*. Freeman.

Lectures will cover the major distinguishing characteristics of important symbiotic relationships. Particular attention will be paid to physiological and biochemical capabilities, nutritional interactions, and important ecological impacts. Attendance at lectures is mandatory, and it is expected that students will have read the assigned material from the texts and on reserve in the library before lecture. Lectures will be augmented with specific information provided through students' presentations.

Presentations: Each student will give an in-depth lecture (15-20 minutes) on a specific symbiosis. Students will be required to use PowerPoint for this presentation, and we will have a PowerPoint training session in the CAL. Symbioses will be chosen during the first week of class. Presentations will be on Friday mornings or at the end of scheduled lecture periods. Material in student presentations will be on the final exam.

Laboratory

During the first part of the quarter, there will be a number of "canned" labs that must be thoroughly recorded in a laboratory book. Topics include the following: nodulation, gut flagellates, lichen identification, algal contribution to cnidarian health, parasites in canine fecal material, etc. Some of these labs will be descriptive and others will be experimental. Friday morning lab is scheduled in order for students to complete unfinished work, work on fulfilling their parasitology lab assignments, and work on their projects. A list of required parasite observations will be handed out in class. You should be prepared to spend additional time in the lab beyond that outlined in the schedule (*e.g.*, the nodule lab will be on-going over 5 weeks!). A key will be available in a lockbox so that students can enter the lab during non-scheduled times. There will be a lab clean-up session at the end of the quarter (**11/30**). Participation in the clean-up session is mandatory, and failure to participate in the clean-up session will result in loss of credit.

Seminars will cover specific topics in symbiosis research and will be conducted as an advanced science seminar. That is, students will be assigned readings from primary scientific literature, and each seminar period two to four students will be responsible for exhaustively presenting the research papers to the group. This of course will require substantial extra time in the library researching background material necessary to thoroughly understand and present the assigned material. A schedule for seminar presentations will be constructed on the first day of the program. There are no allowances for missing seminar on the presentation date or changing dates after the first week of class. Attendance at all seminars is expected, and all students are required to have read the assigned papers before seminar discussion.

Exam

There will be one in-class examination on Wednesday, Nov. 23rd.

Projects

The research project will focus on a specific symbiosis. It may be either descriptive or experimental. Research subjects must be chosen by the end of the third week. Students can undertake their projects in groups of one or two people. The results of your research will be presented in a web-based format. Web pages will be presented at the end of the quarter (Wednesday March 10th). Web pages will include background information that will require library research in the primary literature. All photos and information on your webpage must be your own.

Email

All students must have an email account and agree to check it regularly. It is unlikely that Erik will return a phone call. Some assignments will be distributed via email. Please send Erik an email message by Thursday afternoon of week one with "email address" as the exact subject line. Students not doing this will be dropped from the class on Friday morning via a short note to the registrar stating you are not participating in the program.

Thanksgiving Break Announcement

For obvious pedagogical reasons, this program observes an abbreviated Thanksgiving Break. Class will be held on Monday (11/21), Tuesday (11/22), and the final exam will be on Wednesday, Nov. 23rd. Evaluation conferences will take place during week 10 of the quarter, and students will achieve an extended winter break. Please insure now that your personal schedule does not conflict with the exam date.

PROGRAM COVENANT

Symbiosis Fall, 2005

1. A prerequisite survey will be completed by each student on the first day of class. Students not meeting the prerequisites will be dropped from the program.
2. If you are having difficulty with some aspect of the reading assignments, lectures, seminars, laboratory work, presentations or projects please see me ASAP in order to minimize potential problems and negotiate loss of credit.
3. You must read the syllabus and all other handouts.
4. You will send Erik an email message by Thursday afternoon of week one with "email address" as the EXACT subject line. Students not doing this will be dropped from the class.
5. You will maintain an email account and check it daily.
6. I will respond to emails in a timely manner.
7. I will not return phone calls.
8. All assignments must be completed on time.
9. Missing assignments, seminars, labs, *et cetera* will result in loss of credit. No make-up exams will be given.
10. Assignments turned in after the due date will not be evaluated.
11. I will evaluate assignments as quickly as possible.
12. Incompletes will not be awarded.
13. We will keep laboratory spaces as clean and tidy as possible.
14. We will use the metric system in this upper division science program.
15. If there is a problem that arises in the program, you are responsible for informing me ASAP.
16. Remember the adage "a milligram of prevention is worth a kilogram of cure".
17. We will observe the Evergreen Social Contract at all times (<http://www.evergreen.edu/social.htm>).
18. Plagiarism will result in dismissal from the program and loss of all 16 credits* for the entire quarter. Please visit these two websites, <http://www.fas.harvard.edu/~expos/sources/chap3.html> & <http://www.evergreen.edu/studenthandbook/rules.htm>, for information about avoiding plagiarism.
19. I will send out 5th week warning letters at the start of week six to inform students that may be in danger of losing credit at that time. I will invite those students to discuss this with me during a week 6 appointment.
20. I will be available after class on Monday mornings in Lab 1 3065 to discuss any questions you may have about symbiosis.
21. "Symbiosis" is an upper division science program, and credit will only be awarded to students whose work demonstrates learning at an advanced level.
22. Work performed at a poor level will not be awarded credit.
23. No lower division credit will be awarded.
24. Students will complete a self evaluation and an evaluation of Erik before their evaluation conference.
25. I will complete student evaluations as quickly as possible. My evaluations will be clear, concise and truthful.
26. If there is something in the program syllabus, schedule or covenant that is not acceptable, you should not enroll in "Symbiosis".
27. By continuing in the program beyond the first day, students agree to complete the course as outlined in the syllabus and agree to follow this covenant.

Symbiosis Lecture and Laboratory Schedule Fall 2005

(NOTE: This schedule does not include the Monday seminar schedule and does not include the Friday student presentation schedule.)

- Week 1**
- 9/26 Lecture: Introduction to symbiosis
Readings: Douglas, pp. 1-132; Paracer & Ahmadjian, Ch. 1
- 9/27 Laboratory: Intro to symbiosis laboratory, lab safety, Laboratory: *Rhizobium* isolation and *Trifolium* inoculation (**on-going for 5 weeks**)
- 9/28 Lecture: Rhizobia and nitrogen fixation
Readings: Douglas, pp. 25-28, 47-51, 63-67, 94-99, 118-122; P&A, Ch. 5
- 9/30 Laboratory: Project Planning
CAL Workshop: PowerPoint
- Week 2**
- 10/3 Lecture: Rhizobia and nitrogen fixation continued
Readings: Douglas, pp. 25-28, 47-51, 63-67, 94-99, 118-122; P&A, Ch. 5
- 10/4 Laboratory: microscopy lecture & demonstrations, some parasites (Readings: Dailey, Chs. 2 & 3)
- 10/5 Lecture: Parasites #1 Readings: Roberts & Janovy (on reserve), Chapters 1-3
- 10/7 Laboratory: Project Planning & Microscopy demonstrations
- Week 3**
- 10/10 and 10/12 Invertebrate-algal symbioses
Readings: Douglas, pp. 12-15, 56-62, 100-110; P&A, Ch. 10
- 10/11 Lab (²/₃ class meets): Oxygen uptake and release by an invertebrate-alga symbiosis
- 10/14 Lab (¹/₃ class meets): Oxygen uptake and release by an invertebrate-alga symbiosis
CAL Workshop: Introduction to Dreamweaver
- Week 4**
- 10/17 Lecture: Microbial/animal symbioses
Readings: Douglas, pp. 15-17, 29-46, 68-81, Smith & Douglas, Ch. 8; P&A Ch. 3; Dunlap & McFall-Ngai (1987). Initiation and control of the bioluminescent symbiosis between *Photobacterium leiognathi* and leiognathid fish. *Annals of the N. Y. Acad. of Sciences*. 503: 269-283.
- 10/18 Laboratory: Termite gut symbiosis and Fecalyzer investigation
- 10/19 Lecture: Parasites #2 Readings: P&A, Ch. 9
- 10/21 Laboratory: Parasite microscopy continued
CAL Workshop: Introduction to Dreamweaver 2
- Week 5**
- 10/24 Lecture: Lichens
Reading: Smith & Douglas, Ch. 6; P&A Ch.
- 10/25 Laboratory: Lichens and mycorrhizae in the field and lab
- 10/26 Lecture: Mycorrhizal fungi Readings: Douglas, pp. 5-7, 15-22, 57-61, 114-117; Smith & Douglas, Ch. 7; P&A Ch. 8
- 10/28 Laboratory: Finish parasite microscopy (Readings: Dailey, Chs. 4, 5, 6 & 7)
CAL Workshop: Dreamweaver file management
Lab books due at end of Week 5
- Week 6 Down week**
Mandatory faculty/student conferences. Students work on projects.
- Week 7**
- 11/7 Lecture: Chemoautotrophic symbioses, etc.
Reading: Fisher, C. R. (1990). Chemoautotrophic and methanotrophic symbioses in marine invertebrates. *Reviews in Aquatic Sciences*. 2: 399-436.
- 11/8 Laboratory: Work on projects.
- 11/9 Lecture: Parasites #3
Readings: P&A, Ch. 11
- 11/11 Laboratory: Work on projects.

- Week 8** 11/14 Lecture: Social symbiosis
 Readings: P&A Ch. 13; Hölldobler, B. (1971) Communication between ants and their guests, in Gould and Gould, eds., (1989) *Life at the edge*. W.H. Freeman; Wilson, E. O. (1975) Slavery in ants, in Gould and Gould, eds., (1989) *Life at the edge*. W.H. Freeman; Poulin, R. & A.S. Grutter (1996) Cleaning symbioses - Proximate and adaptive explanations. *BioScience*, 46: 512-517.
- 11/15 Laboratory: Work on projects
 11/16 Lecture: Evolution and symbiosis
 Readings: Douglas, Ch. 8; P&A, Ch. 6
 11/18 Laboratory: Work on projects
- Week X** 11/21 Lecture: Viruses Reading: P&A Ch. 2
 11/22 Recitation Review Session
 Laboratory: Work on projects & Web pages
 11/23 Final Exam
 11/24 Thanksgiving Day
- Week 9** 11/28 Lecture: Summary
 11/29 Finish Project presentations
 11/30 Laboratory: Lab clean-up >>> participation is mandatory (**Lab books due**)
 12/2 **Project presentations**

Week 10 Evaluation Conferences

Weekly Schedule

Mon	Tues	Wed	Fri
8:30-11:00 Lecture (C1105)	8:30-17:00 Lab (Lab1 3046)	11:00-13:00 Lecture/Presentations (LH2)	8:30-12:30 Lab (Lab1 3046)
13:00-15:00 Seminar (B3109)			9:00-11:00 Presentations (D3109)
			13:00-15:00 Workshop (CAL)

Some Selected Important Dates to Remember

- 10/14 Project descriptions due by Friday of Week 3
 10/28 Laboratory: Turn in Lab books
 Week 6: Down Week: Faculty/Student conferences
 11/23 Final Exam: **Wednesday, November 23rd**.
 11/30 Mandatory Lab Clean Up at 9 AM on Wednesday 11/30: Lab books due at this time
 12/2 Project presentations Friday 12/2 in the CAL