

# CORNELL UNIVERISTY

## Chemical Ecology – Spring 2012 - BioEE, Entom, & BioNB 3690

Lectures MWF 11:15-12:05 A106 Corson Hall (Morison Room)

**Course Coordinator:** Andre Kessler, ak357, 254-4219, E445 Corson Hall, Office hours: TBA

**Teaching Assistant:** Katherine (Katie) M. Marchetto. kmm388

### Lecturers:

Anurag Agrawal, aa337, E425 Corson Hall

Charles Linn, cell, 631 Barton Laboratory, Geneva

Georg Jander, gj32, Boyce Thompson Institute

Jennifer Thaler, jst37, 4138 Comstock Hall

Robert Raguso, rar229, W355 Mudd Hall

**Course Website & Readings.** A course pack has been prepared with all of the required readings. For those wishing to save paper, required readings also are available via blackboard (<http://blackboard.cornell.edu/>), where handouts and any course notices will be posted. You must have a blackboard account so we can authorize you to access the website, and a Net ID and password to log in. Please read the assigned materials before you come to class. Ten of those reading assignments will be graded and together make up 20% of your grade (see below). In addition, you will get more out of lectures, as the readings often provide background or additional material not covered in class. There will be several periods devoted to discussion, for which the readings will be important as well.

### Grading

Midterm exam (in class) - 25%, Final exam (comprehensive, during exam period) - 30%

Perspectives Paper (see below) – 25%, Reading assignments (10 papers) – 20%

### Perspectives Paper

*Science* and *Nature* are weekly, peer-reviewed journals that publish top research as well as reviews and commentaries. Because these journals are read by scientists in a wide range of fields, some of the technical articles are accompanied by a summary, which includes background information and recent advances in the field (“Perspectives” in *Science*; “News and Views” in *Nature*). These pieces do not attempt to review everything known about a particular topic, instead they focus on the paper published in that issue to enable scientists from many disciplines to understand and appreciate its importance. A typical Perspectives article explains the broader context the work fits into, provides a succinct description of the methods and results of the study, discusses related studies, and identifies still unanswered questions or likely directions of future research. I suggest you look through issues of *Science* and *Nature* to get a sense of the scope of these articles. We have posted five research articles and their perspectives in a folder on our Blackboard site.

**Course Website & Reading Assignments.** A course pack is available with all of the required readings as well. All readings are also available via blackboard (<http://blackboard.cornell.edu/>), where readings, handouts and any course notices will be posted. You must have a blackboard account so we can authorize you to access the website, and a Net id and password to log in. We expect you to have read the assigned readings before you come to class on the assigned day. You will have to answer certain questions about a total of 10 readings online. These online questionnaires will be graded and, as a total will make up 20% of your grade. Moreover, the readings often provide background or additional material not covered in class. In addition, there will be several periods devoted to discussion, and the readings will be important here.

## Syllabus

### January

#### A Primer in Chemical Ecology

23 – Agrawal: Introduction to course, instructors, and philosophy of the course.

Why a focus on chemical ecology and interactions between insects, plants, and microbes?

25 – Agrawal: Chilies, capsaicin, seed dispersal, and use by humans ([Tewksbury and Nabhan 2001](#))

27 – Agrawal: An ecological primer on interactions between species ([Whittaker and Feeny 1971](#))

30 – Agrawal: Deceptive Pollination

### February

1 – Agrawal: Animal defense and toxicity ([Berenbaum 1995](#))

3 – Agrawal: Coevolution

6 – Agrawal: Host shifts

8 – Agrawal: Pheromones

10 – Agrawal: Demo, Eisner, Discussion ([Eisner 1964](#))

#### Functional Analysis of Natural Product Chemistry

13 – Raguso: Primer on chemistry

15 – Raguso: Review of chemical methods

#### Chemical Communication in Mutualisms

17 – Raguso: Legitimate pollination 1

20 – Raguso: Legitimate pollination 2: toxic nectar and outcrossing. ([Kessler et al. 2008](#))

22 – Raguso: Mutualisms 1: nursery pollination in yuccas and figs. ([Chen et al. 2009](#))

24 – Raguso: Mutualisms 2: Fruit dispersal

27 – Raguso: Discussion

29 – **Mid-term exam**

### March

#### Plant defenses

2 – Thaler: The story of tannins (conditionality and cause and effect)

5 – Thaler: The importance of herbivory ([Becerra et al. American Zoologist 2001](#))

7 – Thaler: Plant defense and herbivore counterdefense 1

9 – Thaler: Plant defense and herbivore counterdefense 2

12 – Thaler: Why are there so many secondary compounds? ([Stephenson and Baldwin, 2007](#))

14 – Thaler: Induced resistance ([Viswanathan et al. 2005](#))

16 – Thaler: Plant to plant communication

---spring break---

Mechanisms of Plant Behavior

- 26 – Kessler: Elicitation of plant responses I: Plant signals (Kessler et al 2004)
- 28 - Kessler: Elicitation of plant responses II: Signals in insects
- 30 – Kessler: Resource allocation and cost of chemical defenses (Fine et al 2006)

**April**

Chemical Information and Community Ecology

- 2 - Kessler: Multitrophic interactions 1: Tritrophic concepts
- 4 – Kessler: Multitrophic interactions 2: Volatiles and multiple mixed messages (Heil and Karban 2010)
- 6 - Kessler: Chemical information mediating community dynamics
- 9 – Kessler: Discussion

*The perspectives paper is due to the TA by the end of the day April 11, 2012*

Chemical Ecology of the Deep Blue

- 11 – Kessler: Aquatic and Marine Chemical Ecology: Tetrodotoxin and Saxitoxin, super toxins from the deep blue (Zimmer and Ferrer 2007)
- 13 – Kessler: Aquatic and Marine Chemical Ecology: “Schreckstoffe”

Insect Pheromones

- 16 – Linn: Moths and sex pheromones I: Females signal and males respond (Lassance, 2010)
- 18 - Linn: Moths and sex pheromones II: Males signal and females respond
- 20 - Linn: Chemical ecology: an essential component of Integrated Pest Management (short Discussion on Friday)(Agelopoulos et al. 1999)

Chemical communication in social systems

- 23 - Jander: Social insect odor communication (Jackson et al 2004)
- 25 – Jander: Honeybee pheromones
- 27 – Jander: Mouse chemical ecology I (Shah and Breedlove 2007, Kimchi et al 2007)
- 30 – Jander: Mouse chemical ecology II

**May**

- 2 – Jander: Human chemical ecology I (Weller 1998, Stern and McClintock 1998)
- 4 – Jander: Human chemical ecology II/ Discussion