adding sequence w/ Biol 101

The Ohio State University
General Education Curriculum (GEC)
Request for Course Approval Summary Sheet

1. **Academic Unit(s) Submitting Request**

   Department of Entomology, College of Biological Sciences

2. **Book 3/Registrar's Listing and Number** (e.g., Arabic 367, English 110, Natural Resources 222)

   Entomology 333

3. **GEC areas(s) for which course is to be considered** (e.g., Category 4. Social Science, Section A. Individuals and Groups; and Category 6. Diversity Experiences, Section B. International Issues, Non-Western or Global Course)

   Category 3, Natural Sciences. Section C, Biological Science. Sequence with Biology 101

4. **Attach:**
   - **A statement as to how this course meets the general principles of the GEC Model Curriculum and the specific goals of the *category(ies) for which it is being proposed;***
   - **An assessment plan for the course; and**
   - **The syllabus, which should include the category(ies) that it satisfies and objectives which state how this course meets the goals/objectives of the specific GEC category(ies).**

5. **Proposed Effective Date** **Spring, 2008**

6. **If your unit has faculty members on any of the regional campuses, have they been consulted?** ___**No**____

7. **Select the appropriate descriptor for this GEC request:**

X **Existing course with no changes to the *Course Offerings Bulletin* information.** Required documentation is this GEC summary sheet and the course syllabus.

☐ **Existing course with changes to the *Course Offerings Bulletin* information.** Required documentation is this GEC summary sheet, the course change request, and the course syllabus.

☐ **New course.** Required documentation is this summary sheet, the new course request, and the course syllabus.

For ASC units, after approval by the academic unit, the documentation should be forwarded to the ASC Curriculum Office for consideration by the appropriate *college curriculum committee and the Arts and Sciences Committee on Curriculum* and Instruction (CCI). For other units, the course should be approved by the unit, college curriculum committee, and college office, if applicable, before forwarding to the ASC Curriculum Office. E-mail the syllabi and supporting documentation to asccurrofc@osu.edu.

8. **Approval Signatures**

Susanne J. Fahler — 2/26/08
Academic Unit **Date**

Caroline Bierenbaum — 2/26/08
College Office/College Curriculum Committee **Date**

[signature] — 3-4-08
Colleges of the Arts and Sciences Committee on Curriculum and Instruction **Date**

Office of Academic Affairs **Date**

Entomology 333
Rationale for Natural Science sequence

The material presented in Entomology 333, "Social Insects," is very much dependent on the material presented in its prerequisite, Biology 101. Dr. Wenzel, who developed this course, is also a frequent instructor in Biology 101, and therefore has a solid understanding of the framework of biological knowledge acquired by students in Biology 101. This course examines research ranging from classical essays to modern research papers, and students review work by two Nobel laureates (Niko Tinbergen, Karl von Frisch) and a two-time Pulitzer Prize winner (Edward O. Wilson).

The major concepts of biology that are covered in Biology 101 include evolution, genetics, and bioenergetics. These concepts will be integrated throughout the discussion of insect societies in the "Social Insects" course. In the "Social Insects" course, students will use their knowledge of evolution to understand the forces that shape the development and maintenance of complex insect societies. At the same time, their exploration of these societies will reinforce and deepen their understanding of evolution, and introduce concepts related the basis of intelligence and symbolic language, to social theory, to the organization of work, and mathematical relationships that determine functional elements ranging from economies of scale to allometry of body parts. Similarly, the students' understanding of genetics will be deeper and more detailed after they have applied genetic concepts to the study of social organization, and examined the "inclusive fitness" and sex ratio manipulation of social insects as a means to perpetuate the genes of individuals within the colony, or of the colony within the population of colonies. An understanding of bioenergetics is critical to the analysis of the costs and benefits of social organization, and is reinforced throughout this course by cybernetic perspectives in organizing labor and maximizing efficiency of foraging and handling.

Because Entomology 333 builds on and expands the students' understanding of the major concepts of biology introduced in 101, we request that the Biology 101-Entomology 333 sequence be approved as a two-course sequence in the Biological Sciences category of the GEC.

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Date: October 1, 2007
To: Curriculum Committee, Department of Entomology
Curriculum Committee, College of Biological Sciences
Curriculum Committee, Colleges of Arts and Sciences
From: John W. Wenzel, Professor, Department of Entomology
Re: New GEC course, Social Insects.

I present a proposal for a new course, Entomology 333, Social Insects. This course is intended to fill a role as a new GEC course, open to students who have had Biology 101 or equivalent. The course is a streamlined version of the popular Honors course Entomology H444, the difference being that a recitation run by the GTA is substituted for the hands-on, live animal labs that I direct in person in H444. This course includes review of material that earned the Nobel Prize (orientation, imprinting and kin recognition, honey bee dance), as well as reading from two-time Pulitzer Prize winner Edward O. Wilson. The course will explore biological and cybernetic factors that permit ants, bees, wasps, and termites to maintain large and complex societies. The course includes mathematical perspectives (some simple algebra and geometry, along with sampling theory) as well as philosophical quandries (what constitutes a society? cooperation? altruism? complexity?). Requiring only Biology 101 (or equivalent), the course will handle these elements with care to be sure that students who are not well prepared for certain challenges grasp the meaning and importance without being penalized for learning only limited aspects. For example, while geometric principles behind the honey bee dance language are explained, students do not have to perform mathematical calculations.

Lecture: Three per week; standard, 48 minute presentations, using both Powerpoint and hand writing/illustration on overheads. Each lecture begins and ends with a brief question/answer period. Two lectures make use of commercial videos. Lecture notes are distributed through Carmen prior to class.
Recitation: Weekly, one-hour periods will include discussion of lecture material and amplification of this content through additional assignments and practical demonstrations performed in class. Some may be performed live, in a small arena, projected to a screen, others will be studied from video recordings made in the laboratory:
Week 2: Simple navigation rules and simple mazes, with milkweed bugs
Week 3: *Tetramorium* ants and light orientation
Week 4: Trail pheromones
Week 6: *Crematogaster* ants, and choosing the shortest path.
Week 7: Kin recognition in bees.
Week 8: Dominance in sweat bees.
Week 9: Honey bees: dance language
Readings: The majority of topics will be covered using original material written for the Entomology H444. Attached, I offer examples that cover two very different types of topics. The

first is a summary of the natural history of bees (Natural History of Bees.pdf, to go with lecture #5). This is a content-heavy reading, and it is organized in a telegraphic way to help students keep similarities and distinctions clear, and for later use as a look-up reference guide. The other is an introduction to concepts of selforganization (Selforganization-3.pdf, to go with lecture #16, with additional material to follow for #17 and 18.). This reading is conceptual, and composed in a conversational way to facilitate discovery of new ways of thinking. Other sources are listed in syllabus, and I already have permission to use the great majority of this material (including all the Wilson material) for Entomology H444. Required material will be available in hard copy in the workbook available from UniPrint. Additional material, or any material for which permission is discontinued, will be made available online through Carmen to enrolled students, as is commonly done in other courses. Sources that are expected to be part of the syllabus are:

Alcock, J. *Animal Behavior*, pp 219-227.
Borror D. & D. White: *A Field Guide to Insects of North America*, pp 29-41.
EOW: (Edward O Wilson): *Insect Societies*, various pages as listed.
Haldane, J.B.S, *On being the right size.* 1928
Hölldobler, B. & Wilson, E, O. *The Ants*, pp 365-370.
Michener, C. D, & M. Michener, *American Social Insects*, pp 1-5.
Rissing, S. W. & J. Wheeler. *Foraging responses of Veromessor pergandei to changes in seed production*, Pan Pacific Entomologist 52: pp 63-72.
Tinbergen, N. *Curious Naturalists*, pp 8-18, 60-70.
Trivers, R. L., *Social Evolution*, pp 271-289.
Wilson, E. O: *Insect Societies*, pp 249-252.

Grading Instruments.
Grades will be composed of scores from the best three of four quizzes (20 points each, total of 60 pts), a midterm (100 points), a comprehensive final (100), and the best four of five short essays (10 points each, total of 40 pts.) related to material presented in recitation. I expect the essays to be pointed discussions of about 300 words. Some of these may be based on practical demonstrations made available through recorded experiments. Quizzes and exams will be composed of a mix of multiple choice and short answer questions. These test both the factual content and conceptual connections, and they are easy to grade with an eye to continuity across even a large number of students. Below are some examples.

1. Which of the following pairs of comparisons is correct when considering how absolute size influences a species' capabilities?
A. gravity is a greater influence for small animals, but heat is a lesser influence
B. surface tension of water presents a great challenge to small animals, but flight is easier
C. blood pressure is more important to small animals, but starvation is less important
D. flight presents a great challenge to small animals, but gravity is a lesser influence

2. Which of the following is true about trail pheromones?
A. they function best when they are short lived and detected at high concentration
B. each individual scout should have her own unique trail pheromone
C. every colony should differ
D. None of the above

3. Name or describe briefly a species that could be expected to perform "maze learning" very well, and why its natural habitat requires this ability.

4. How do sociality and reproduction in termites connect with Hamilton's inequality as represented by the formula Br>C?

Currently, I plan offer examples of such questions online through Carmen so that they may be used for review in recitation or as a study guide prior to a quiz or exam. Questions may be rephrased or reversed for examination such that rote memorization of the example is not rewarded. For example, multiple choice question 1 above might appear on an exam as:

If an animal flies easily, but has great difficulty passing through water, we could predict that it is probably
A. very large
B. very small
C. immature
D. starving

Or, multiple choice question 2 above may be presented in the exam as a short answer:

Why do trail pheromones function best when they are short lived and detected at high concentration?

Major Learning Objectives.
Reviewers unfamiliar with the rich traditions of social insect biology may not recognize how many of the major learning objectives are fulfilled in this syllabus. Below, I list lectures that rely upon or teach explicitly the pertinent conceptual issues.

Philosophy of our science:
Lecture 2, What is sociality? Philosophy of individual/group, self or group interest.
Lectures 19, 20 , Kin recognition. same/other, degree of self negation that is favorable if others benefit

Math (algebra, geometry, and logical aspects):
Lecture 3, Hamilton's theorem. Calculation of genetic similarity, algebra
Lecture 7, Scale. Laws of physics, mathematical scaling
Lecture 6, Honeybee dance. Geometry and trigonometry.
Lecture 13, Sex ratio. Algebra and probability theory
Lectures 16, 17, 18, Selforganization.. Algebra, logical problem solving.
Lecture 24, Caste in ants. Mathematical scaling, allometry.

History of events and discoveries:
Lecture 2, What is sociality? Development of modern perspectives on cooperation, order, and organization.
Lecture 13, Sex ratio. Successive discovery of increasingly complex strategies.

Technology (a cybernetic perspective):
Lecture 12, Little creatures that run the world. Robotic perspectives, general view.
Lectures 16, 17, 18, Selforganization. Robotic perspectives, mathematical view.
Lectures 6, 22, Orientation. Engineering of perceptive ability and function of eyes

Integration of diverse foundations:
Lectures 16, 17, 18, Selforganization. Resource ecology, and robotics of foraging.
Lectures 24, Caste in ants. Mathematical allometry and social theory.
Lecture 28, Nest Architecture. (Touches lightly nearly everything.)

I hope you will approve this new course to extend a successful Honors House offering to our OSU students at large.

Sincerely,

John W. Wenzel
Professor of Entomology
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http://www.biosci.ohio-state.edu/~wenzel/