Term Information

Effective Term	Autumn 2014

General Information

Course Bulletin Listing/Subject Area	Entomology
Fiscal Unit/Academic Org	Entomology - D1130
College/Academic Group	Food, Agric & Environ Science
Level/Career	Undergraduate
Course Number/Catalog	2101
Course Title	Insects and Human Affairs: Pests, Plagues, Poisons and Politics
Transcript Abbreviation	PestsPlagues
Course Description	Insects are a daily fact of life, exerting major influence on human affairs over the course of history. The course analyses the extensive and sometimes uncomfortable relationships between insects and humans, including historical roots of insect/human interactions, impact of insects on development of scientific thought, use of insects as experimental models in drug design and military applications.
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Laboratory, Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	
Exclusions	Not open to students with credit for 102

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.0702
Subsidy Level	General Studies Course
Intended Rank	Freshman, Sophomore, Junior, Senior

Quarters to Semesters

Quarters to Semesters	Modified or re-envisioned course that includes substantial parts of the content and learning goals of one or more quarter courses
List the current courses by number and title that are to be subsumed into proposed course	Entomology 102, Insect Biology-II

Requirement/Elective Designation

General Education course:
Biological Science

Course Details

Course goals or learning objectives/outcomes

- Goal: understand how insects have contributed to theories and methods of science, the relationship between science and technology and the implications of scientific discoveries and the potential of science to address contemporary problems.
- Learning Outcome 1: Students will understand insects' role in establishing key biological principles, facts and theories such as the germ theory of disease and the modern synthesis.
- Learning Outcome 2: Students will understand key events in the development of science as it relates to insect borne diseases, their treatment and control and how these events impacted human history.
- Learning Outcome 3: Students will be able to describe the inter-dependence of scientific and technological events by understanding the use of insects as models in medicine and in defense.
- Learning Objective 4: recognize the social/philosophical implications of scientific discoveries and the potential of science/technology to address contemporary issues by examining how insects changed human perception and beliefs about nature.

Content Topic List

- Insects in divine texts, myths and fables---the use of insects to explain biological phenomena is explored using the species scape concept.
- Sound production in insects--students learn about the anatomy and morphology of sound producing organs in insects. The use of insects as inspiration in human music is discussed.
- Biology of Insect-vectored disease--students learn about the anatomy, physiology and morphology of insect-borne disease transmission.
- Fear of insects---the evolutionary roots of fear of insects is explored as well as specific psychological conditions, e.g., delusionary psychosis and insects in dreams.
- The Black Death--students study the complex interplay between fleas, rats and the plague bacterium that resulted in one of the most devastating pandemics in human history. The effects on society, medicine and society are recounted.
- Insects at war--the importance of insect-borne disease in determining the outcome of armed conflict are studied using Napoleonic campaigns in Egypt, Haiti and Russia as examples.
- The Rise of the Pesticide Industry following successful deployment of DDT in WWII is studied. Technological impediments to synthesizing insecticides on a massive scale are studied. The impact of insecticides on ecology are covered.
- Insects as biological weapons of war--use of insects as weapons of war are covered from biblical times to the federal agency known as DARPA. Effectiveness and technological constraints are detailed.
- Insect Defense Compounds--potential for using insect secondary chemicals for human purposes are explored.
- Role of insects in feeding humans--entomophagy around the globe is considered as well as technological and psychological impediments to increasing the value of insects as a human food source.
- Comparison of insect and human nutrition---anatomy and morphology of insect and human digestive system is studied with emphasis on energy and metabolic requirements of each organism.
- Insects in medicine--the use of insects in medicine is detailed from Pliny's Doctrine of Signature to the use of maggots to debride wounds in modern hospitals.
- Bugs as drugs---the potential for insect-based products to serve as therapeutics for human disease is explored.
- How insects changed science--the role of insects in elucidating the germ theory of disease is discussed as well as how the nature of science was changed by this discovery.
- Insects and the modern synthesis--T.H.Morgan's work on mutation in Drosophila and its importance to the establishment of the modern synthesis is covered.
- Pollination services---the economic value of insects is largely unsung and unnoticed. But, the contributions of pollinators is significant. Students learn how pollination works and ecological and pathological threats to pollinators.
- Silk production is another way in which insects/arthropods benefit the economy. The biology and chemistry of silk production is covered as well as a taxonomic look at which organisms make it.

Attachments

- Entomology 2101.doc

  (Syllabus. Owner: Fisher,Susan Warwick)

- Entomology 2101Course Assessment.doc

  (GEC Course Assessment Plan. Owner: Welty,Celeste)

- Entomology 2101GEC Natural Science.doc

  (Syllabus. Owner: Welty,Celeste)

- Entomology2101GERationale.docx

  (GEC Model Curriculum Compliance Stmt. Owner: Welty,Celeste)

Comments

- See 11-26 e-mail. *(by Vankeerbergen,Bernadette Chantal on 11/26/2012 03:21 PM)*
- Use replacement syllabus to evaluate this course. *(by Welty,Celeste on 11/07/2012 02:16 PM)*
- I believe you wanted this course sent back. If not push it forward again. *(by Pfister,Jill Ann on 11/05/2012 08:55 AM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Fisher,Susan Warwick	06/15/2012 09:39 AM	Submitted for Approval
Approved	Pfister,Jill Ann	07/26/2012 08:03 AM	Unit Approval
Revision Requested	Pfister,Jill Ann	11/05/2012 08:55 AM	College Approval
Submitted	Welty,Celeste	11/07/2012 02:19 PM	Submitted for Approval
Approved	Pfister,Jill Ann	11/19/2012 09:46 AM	Unit Approval
Approved	Pfister,Jill Ann	11/19/2012 09:55 AM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	11/26/2012 03:22 PM	ASCCAO Approval
Submitted	Welty,Celeste	01/04/2013 03:00 PM	Submitted for Approval
Approved	Pfister,Jill Ann	01/07/2013 06:10 PM	Unit Approval
Approved	Pfister,Jill Ann	01/07/2013 06:11 PM	College Approval
Pending Approval	Nolen,Dawn Jenkins,Mary Ellen Bigler Vankeerbergen,Bernadette Chantal Hogle,Danielle Nicole Hanlin,Deborah Kay	01/07/2013 06:11 PM	ASCCAO Approval

Entomology 2101
Insects and Human Affairs: Pests, Plagues, Poisons & Politics
Spring 2013
Dr. Susan Fisher, Instructor
236 Kottman Hall
fisher.14@osu.edu
292-1617
3 Credit Hours

Course Format: 2 one hour lectures/week (MTF)
1 two hour laboratory/week

Fulfills the General Education Natural Science Requirement for the BA

Course Description: Insects have invaded every environment imaginable from the binding of books to human skin. Thus, insects are a daily fact of life and have exerted considerable influence on human affairs over the course of history. This course analyses the extensive and sometimes uncomfortable relationship between insects and humans, including historical roots of insect/human interactions both positive and negative, impact of insects on development of scientific thought and use of insects as experimental models in drug design and military applications.

Student Learning Goals: Students will understand the impact of insects on human affairs both positive and negative.

Expected Learning Outcomes:

Learning Outcome 1: Students will understand the basic facts, principles, theories and methods of modern science

Learning Outcome 2: Students will understand key events in the development of science and recognize that science is an evolving body of knowledge.

Learning Outcome 3: Students describe the inter-dependence of scientific and technological developments.

Learning Objective 4: Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

Course Format

I. Lectures

Lecture Number	Lecture Topic

1	Introduction and Administrivia
2	How Humans Understand the World: Insects as Myth
3	Faith and Biology: Insects and the Abrahamic Faiths
4	Sound Production by Insects
5	How and Why insects make music
6	How insects taste the world: chemoreception and how humans can use it
7	Fear of Insects—Evolutionary roots and Biological Basis
8	Insects in Dreams—Neurobiology and Psychological Significance
9	Serial Killers—Biology of Insect Borne Diseases
10	Hour Exam I
11	Flee Wikkyd Heires and Loose Women: A Primer on the Biology of the Black Death
12	Was Napolean Defeated by Insects? Three Case Studies: I. Napoleon, Plague and Egypt
13	II. Yellow Fever, Napoleon & Haiti
14	III. Typhus, Napoleon and the Russian Winter
15	DDT: Miraculous Powder or Elixir of Death?
16	The Rise and Influence of the Pesticide Industry
17	Modern Warfare: Insects as Biological Weapons of War
18	Insect Defense Compounds and Their Manipulation by Humans
19	Hour Exam II
20	Insect Cuisine—You eat what??????

	Role of Insects in Feeding Humans around the Globe
21	The Basic Biology of Nutrition—Energy Cycles
22	A comparison of insect and human nutrition
23	Insects in Medicine—Ancient to Modern Practices
24	Of Venoms, Poisons and Insect-Based Cures: Bugs as Drugs
25	How Insects Changed Science—Pasteur and the Germ Theory of Disease
26	T.H. Morgan and the role of insects in creating the Modern Synthesis
27	Silk, its historical significance and modern uses
28	Pollination Services: Ecological & Economic Benefits

Text

At present, there is no published text book that offers adequate coverage of the diverse topics found in this course. However, I am in the process of writing one and a draft will be available by Spring 2014. I am also supplementing the course with an extensive reading list for the recitation section which is detailed below. Students will also asked to invest in a package of 3x5 index card which they should being to each class. We ask the students to write down any questions they have about the material covered in lecture. Please list concepts that were unclear or topics over which you'd like additional coverage. Please give these cards to the TA after each class so that he/she can address points of uncertainty in recitation.

Course Evaluation and Assessment

Your grade in this course will be determined from the following:

Assessment of Lecture Content:

1. **Hour Exam 1**—100 points
2. **Hour Exam 2**—100 points
3. **Comprehensive Final**—100 points

Assessment of Laboraty Content:

1. **Laboratory Participation**—50 points. Students will be awarded up to 5 points each week for participation in laboratory discussions. In addition to contributing to the general discussion, students will be graded on their ability to articulate the benefits and problems associated with insects in science.
2. **Semester Long Recitation Project**—100 points
3. **Weekly laboratory exercises**—100 points

Total Possible Points in Course: 550

Grading Scale:

93-100 A
90-92 A-
87-89 B+
84-86 B
80-83 B
77-79 C+
74-76 C
70-73 C-
67-69 D+
64-66 D

Laboratory Schedule

Week 1---no Lab
Week 2—creating an insect myth to explain some biological principle (**graded recitation exercise due in recitation, week 3**)
Week 3—fear of insects, a cinematic experience—students will analyze the biological accuracy of how insects are depicted in horror films
Week 4—Insects and human disease: Analysis of insect adaptations for blood feeding **(graded recitation exercise due week 5; topics for quarter long project must be approved by TA by week 4)**
Week 5—Silent Spring—the movie and the book. Understanding environmental toxicology and social impact of insecticides
Week 6 Understanding Insects and the course of war: experiments with insects that infest grain
Week 7 Insects and nutrition---a comparative study (**graded recitation exercise- due in recitation, week 8)**)
Week 8—What can you eat---according to the Bible and is there a biological basis? (**graded recitation exercise, due in recitation, week 9**)
Week 9 Insects and medicine
Week 10 Drosophila melanogaster and the genetics of mutation
Week 11—student presentations
Week 12—student presentations

Week 13—student presentations
Week 14—review for final

Semester long student project

Each student will be asked to choose an insect-based project of interest to him or her. Over the course of the semester, each student will perform research on the chosen topic, write a descriptive piece about the topic and create a physical representation of the topic. For instance, a student might choose to study the spiders that are poisonous. After doing research, the student will write a 5-10 page paper (with documentation) on the topic in which he/she might explore the biology of poisonous spiders, possible historical implications of famous spider bites, and the impact of poisonous spiders on art and society, e.g. the Tarantella. The student will then create a painting, song, sculpture, weaving, video, dance, short-story etc. on the subject. Through these diverse activities, the student will come to appreciate the consilient relationship between science, art and human expression.

Students will be asked to identify their topic of choice by week 4 on the semester calendar. Research on the subject should begin immediately thereafter. The TA will check for progress every week in recitation. The final three recitation periods will be devoted to student presentations which will include a synopsis of their research along with an explanation and discussion of their creative project. **The whole project must be completed by the time of laboratory during week 11**. Presentations by individual students should be 10-15 minutes in length.

Semester-Long Projects will be graded as follows:

Research paper: 30 points
Creative project: 50 points
Presentation: 20 points

Rubrics for grading the paper and the creative project will be handed out in class.

Absences: Students are expected to attend both lectures and recitation during each period it is offered. Attendance in lecture will not be taken. However, attendance in recitation will be taken by the TA and will be used, in part to determine your participation grade. The TA will record participation (assessed as none (0), moderate (1) or high (2). The total points will be tallied for the quarter and used to determine your participation score. If you are too ill to take an exam, please contact your TA or Dr. Fisher within 24 hours of the class period in which the exam was taken. You must be seen by and receive written documentation from a professional health care practitioner on the day of the exam in order for a make up to be given. Other serious personal problems will be considered, in advance, on an individual basis. In all instances, documentation supporting the excused absence will be required.

Academic Misconduct: OSU has a strict code of academic that requires us to report any and all cases of suspected misconduct (e.g. cheating on an examination, plagiarism in written assignments, using an examination proxy, failure to follow course policies etc.) to the OSU Committee on Academic Misconduct for adjudication. "It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term 'academic misconduct" includes all forms of students academic misconduct wherever committed: illustrated by, but not limited to, cases of plagiarism and dishonest practices in connections with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp)."

Accommodation of Special Needs: Students with disabilities that have been certified by the Office of Disability Services will be appropriately accommodated, and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Ave; telephone: 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/.

Sexual Harassment: OSU considers sexual harassment offenses to be unacceptable behaviors that erodes the quality of the learning environment. Please report any concerns about questionable behavior to Dr. Fisher.

Reading List for Course

Week 1

Excerpts from: Kritsky, G. and R. Cherry (2000). *Insect Mythology*. Writers Club Press, Lincoln, NE, 137 pp.

Amar, Z. ((2002). The Eating of Locusts in Jewish Tradition after the Talmudic Period. The Torah u-Madda Journal. 11: 186-202.

Week 2

Berenbaum, M. (1996). "Let me tell you 'bout the birds and the bees. " Amer. Entomology 42: 134-135.

Hogue, C.L. Cultural Entomology. Ann Rev. Entomol. 32: 181-199.

Week 3

Fleischman, P. (1988). Joyful Noise—Poems for Two Voices. Harper & Row, Pub.

Dethier, V.G. (1993). Crickets and Katydids, Concerts and Solos. Harvard Univ. Press, Cambridge, MA.

Klein, B.A. (2012). The Curious Connection between Insects and Dreams. Insects 3: 1-17.

Week 4

Excerpts from Strassler, R.B (ed.) (1998). **The Landmark Thucydides: A Comprehensive Guide to the Peloponnesian War**. Sections 2.47-2.59 on the Plague, pp. 118-123.

Excerpts from Campbell, D. (1921). Translation by M. Rigg of The Decameron, Bocaccio, G. , Vol. 1, pp 5-11.

The Decameron from Wikipedia, http://en.wikipedia.org/wiki/The_Decameron. 6 pp.

Week 5

Excerpts from: Carson, R. (1961). **Silent Spring**.

Chapter XX *And No Birds Sing*, pp. XXX .

Excerpts from: Marco, G.J., R.M. Hollingworth and W. Durham (1987). Silent Spring Revisited, American Chemical Society, Washington, D.C.

Chapters

1. *Rachel Carson : Her Vision and Her Legacy*, pp. 3-9
3. *The Science and Politics of Pesticides*, pp. 15-22.
8. *Analytical Chemistry of Pesticides: Evolution and Impact*, pp. 127-138.

Week 6

Miller, G.L. (1997). Historical Natural History: Insects and the Civil War. American Entomologist. 43: 227-245.

Week 7

Pemberton, R.W. (1999). Insects and other Arthropods used as Drugs in Korean Traditional Medicine. J. Ethnopharmacol. 65: 207-261.

Sherman, R.a., M.J.R. Hall, and S. Thomas (2000). Medicinal Maggots: An Ancient Remedy for Some Contemporary Afflictions. Annu. Rev. Entomol. 45: 55-81.

Week 8

Researchers Recommend Insect Meat (2011). Healthcare News. http://wwe.hc2d.co.uk/content.php?contentId=17352, 1/28/2011.

Week 9

Excerpts from: Lockwood, J.A., (2008). Six-Legged Soldiers: Using Insects as Weapons of War. Oxford Univ. Press, London, 400 pp.

Bee Bombs and Wasp Warheads, pp. 9-25.
Entomological Evil, pp. 95-107.
Insect Cyborg and Roboflies, pp. 287-297.

Week 10

Excerpts from: Ramos-Elorduy, J. (1998). Creepy Crawly Cuisine. The Gourmet Guide to Edible Insects. Park Street Press, Rochecter, VT., 150 pp.

Entomophagy Around the World, pp. 12-25.
Nutrition and Entomophagy, pp. 38-51.

Week 11

Kenyon, G. (2002). Insects Boost Immune System. BBC News, 2/0.02.

Cherniak, P. (2010). Bugs as Drugs, Part I: insects. The "New" Alternative Medicine. Altern. Med. Rev. 15 (2): 124-135.

Week 12

Berenbaum, M.R., (2007). Colony Collapse Disorder and Pollinator Decline. Statement of M.R. Berenbaum, Professor and Head, Department of Entomology, University of Illinois before the Subcommittee on Horticulture and Organic Agriculture, U.S. House of Representatives, 3/29/07.

Week 13

Allen, D.C. (1999). Insect-Produced Silk: from textiles to tents. The New York Forest Owner, 37: 6.

Week 14

Lewis, E.B. (1998). Thomas Hunt Morgan and His Legacy. http://nobelprize.org/nobel_prizes/medicine/articles/lewis/.

Entomology 2101
General Education Natural Science Course
Assessment Plan

Grades in this course will be determined from the following:

a) **Description of Specific Methods Used to Demonstrate Achievement of Learning Outcomes**

i) **<u>Assessment of Lecture Content:</u>**

1. **Hour Exam 1**—100 points
2. **Hour Exam 2**—100 points
3. **Comprehensive Final**—100 points

The hour exams and final will assess student comprehension at different levels. Objective questions based on matching and fill in the blank formats will assess student retention of fact and understanding of those facts. Ability to apply information to novel situations will be assessed in multiple choice questions, designed to assess different levels of comprehension, based on Bloom's taxonomy. Finally, the students' ability to analyze information, form analogies, and draw conclusions warranted by evidence, will be assessed in essay questions in which students respond to specific prompts. Students will be able to choose from among several essays. Both hourly exams and the final will include each type of question.

<u>ii)Assessment of Laboratory Content:</u>

1. **Participation**—50 points
2. **Semester Long Project**—100 points
3. **Four Graded Laborary Exercises**—100 points total
4. **Five In-class Nongraded Exercises**—These will be filled out and handed in during the relevant laboratory period. They will not be graded but will be used to ascertain assimilation and processing of materials.
5. **<u>Insects in the News:</u>** Students may earn 2 points of extra credit (up to 20 points per student) for each insect-related article or story he/she brings to me prior to the 12th week of class. We will use the articles in lecture to explore how effectively the scientific method is reflected in the popular press and how insects influence our understanding of contemporary society.

Assessment of the laboratory section will include several key elements: weekly contributions to the topic discussion, responses to written laboratory questions (both on formal graded reports and weekly ungraded questions) and the semester long project. Different skills will be assessed in each section.

The quality and quantity of each student's discussion in both laboratory and lecture will be assessed by the GTA each week. Student comments that are particularly notable for their cogency, creativity or analytical content will be noted by the GTA for each student. These scores will be tallied by the GTA and used to determine the participation points for each student.

The four graded laboratory exercises will assess the ability of students to analyze specific insect-based problems for which particular parameters have been specified. In addition, this assessment will entail creative thinking, e.g., the myth project and artistic analysis, e.g., the insect song project. Ability to find documentation, both on- and off- line will also be highlighted as will developing thoughtful responses to questions found in the graded laboratory exercises.

The ungraded exercises will afford the student the chance to check for comprehension of materials, particularly in the discussions of insect in science which tend to be more difficult for nonscientists. These exercises will not contribute to a grade but will help flag difficulties in comprehension which will assist the instructional staff in intervening to assist the student.

The comprehensive semester long project will access and test multiple skill sets in each student. These include the ability to identify a project of interest and of *gravitas*, ability to perform research on the topic with proper documentation, the ability to draw conclusions underscored by evidence and the ability to render an entomological idea into a physical reality in a compelling and creative way. These skills will be assessed in a detailed rubric which will be made available to the students at the start of class.

To further assist students, extra credit will be given to students who bring in insect articles in the news. These will be used to animate laboratory and lecture discussions and to allow students to compensate for point losses on exams. The procurement of the articles will also focus student attention on the many, many instances of insects appearing in the news and will drive home the daily reality of insects in our lives.

Total Possible Points in Course: 550

Grading Scale:

93-100	A
90-92	A-
87-89	B+
84-86	B
80-83	B
77-79	C+
74-76	C
70-73	C-
67-69	D+
64-66	D

b) **Explanation of level of student achievement expected.** In general, for exams, success means that 80% of students answer the questions correctly. For essays, the 10 page written paper and the graded laboratory written assignments, the students will be provided with rubrics for each assignment. Success is an 80% score on the written assignments.

c) **Description of follow-up/feedback processes.** We are using 80% as the criterion for success which is considerably higher than the 70% criterion used in most big body count GE nonmajors courses. To assist students in achieving this goal, we will offer a variety of mechanisms for feedback and revision:

i)To assist in exam preparation, students will be given on-line quizzes every other week that will test key concepts and identify problem areas;

ii) Dr. Fisher will hold review sessions prior to each exam;

iii)For written assignments, students will be encouraged to submit assignments before the due date to obtain feedback from either the GTA or Dr. Fisher so that they can make changes that are likely to improve their grades;

iv) All written assignments will have a rubric which, if followed, should increase the likelihood of student success;

v) Students can earn up to 20 points by bringing in insect-based articles from the news;

vi) Nongraded laboratory assignments will be used to gauge student comprehension of materials and allow us to make mid-course corrections to the presentations if necessary;

vii) The running tally of points earned for discussion will be given to each student each week by the GTA. If the student is dissatisfied with his or her point recovery, the students will be encouraged to discuss the matter with Dr. Fisher or the GTA so that changes can be made to elevate student performance.

At the end of the course, we will use SEI information as well as an analysis of each graded component of the course to identify problem spots and how we might change the course and the presentation of materials to address these problems.

General Education Rationale

Entomology 2101

Insects and Human Affairs: Pests, Plagues, Poisons and Politics

How do Learning Objectives address the GE category Expected Learning Outcomes:

Learning Outcome 1: Students will understand the basic facts, principles, theories and methods of modern science.

Learning Objectives for Learning Outcome 1:

Students will understand the role of insects in establishing key biological theories such as the Germ Theory of Disease and the Modern Synthesis;

Understand the biological facts behind key components of insect physiology, morphology and the nervous system in sufficient detail that to permit evaluation of insect roles in disease transmission and other activities that affect the well-being of humans;

Develop testable, falsifiable hypotheses to explain how insects impact the world in laboratory exercises.

Learning Outcome 2: Students will understand key events in the development of science recognize that science is an evolving body of knowledge.

Learning Objectives for Learning Outcome 2:

Students will:

Explore how the human desire to explain the natural world evolved from mythology to religions to scientific explanations of key phenomena e.g. the origin of the earth and the genesis of humankind;

Understand why efforts to control insects went through distinct eras that evolved from prayers to stop insect depredation of crops, excommunication of offending pests, chemical control of different types and ultimately a reduction of reliance on chemicals as ecological effects where identified and insect resistance to insecticides took root.

Understand the biology of using insects in medicine from ancient practices such as using insects to close wounds to modern use of maggots to debride wounds and insect venoms to fight devastating diseases like glioma.

Learning Outcome 3: Students describe the inter-dependence of scientific and technological developments

Learning Objectives for Learning Outcome 3:

Students will:

Examine the use of insects as weapons of war by investigating ancient to modern practices, focusing on technological aspects of incorporating insects into biological weapons;

Understand the psychology, nutritional analytics and technological impediments to using insects to feed a human population that faces significant food insecurity on a global basis;

Investigate the interaction between microbiology and the machinery needed for silk production in an effort to understand why the silk industry was imperiled in the 19th century.

Learning Outcome 4: Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the world.

Learning Objectives for Learning Outcome 4:

Students will:

Understand the neurobiology of fear of insects and the potential for effective therapeutic treatment of entomophobia, delusionary parasitosis and illusionary parasitosis;

Be able to explain why insects repeatedly appear in divine texts, music and human dreams and explain the biological significance of these phenomena;

Articulate the effects of bubonic plague (and other insect-borne pandemics) on society with particular emphasis on the fecklessness of the institutions upon which we traditionally rely to relieve suffering e.g., clerics, politicians and physicians.

A) How do the readings assigned address the GE category Expected Learning Outcomes?

Learning Outcome 1: Students will understand the basic facts, principles , theories and methods of modern science.

The assigned readings were chosen to serve in place of a text as this is an area that lacks a suitable text book. The readings, thus, cover the basics as well as expand upon chosen themes.

Beginning in week 2, the Berenbaum and Hogue references were chosen to acquaint students with the basic entomology needed for success in the course. The Hogue reference expands the basic entomology to include how insects impact humans.

In week 14, the paper by Lewis recounts T. H. Morgan's quest to discover the source of genetic diversity upon which natural selection acts. This discovery of mutations in fruit flies was the basis of his work and provided the third pillar in the Modern Synthesis. All biology depends upon this understanding.

Learning Outcome 2: Students will understand key events in the development of science recognize that science is an evolving body of knowledge.

Week 1 readings are devoted the role that mythology and religious text had in the nascent understanding of how the world was created and human's place in it. We trace the use of insects in myth, parables and fables as well as key portions of the Torah, Bible and Qur'an in helping students understand how and why insects played a significant role in this process. We finish with excerpts from Stephen Jay Gould's book that describes the modern scientific view of how the earth was formed and its unique features that permitted the evolution of life.

Another phenomenon that has undergone significant change as our understanding of biology increased was our ability to control insects which we considered pests. Methods for insect control prior to the 19th century can best be described as a "wing and a prayer." By the time of WWII, our ability to use chemicals to control insects gained precedence. This was changed radically as our understanding of the secondary effects of insecticides surfaced and evidence for insect resistance to insecticides grew. The major changes in perspective are covered in the readings for week 5 by Carson and Marco et al.

Insects have always played a role in medicine as horrible as that sounds. We will review ancient practices that use insects as therapeutants that are still sometimes used today and "modern" practices that continue to push the envelope. Among the later are anticancer drugs that may be effective in treating diseases such as glioma that have very high mortality rates. The readings from week 7 (Sherman et al (2000)) covers historical aspects of entomology-based medicine. The two articles listed for week 11 (Kenyon 2002) AND Cherniak (2010) provide insight into emerging technologies that are based on insects.

Learning Outcome 3: Students describe the inter-dependence of scientific and technological developments

The use of insects as biological weapons of war has a long and storied history. Sometimes they worked. Sometimes, technological impediments prevent success. We will look at a variety of examples from the use of catapults to launch bee hives into enemy camps to insect cyborgs and roboflies---all topics covered during week 9 in several chapters from Lockwood (2008).

People around the world rely on insects as a food source. Even in the US, we willingly eat shrimp, lobsters and crabs. The FDA prescribes allowable insect levels in processed food demonstrating that even Americans are getting a significant level of insects in their diet. We undertake a nutritional analysis of eating crickets vs. cows and discover that eating crickets would be a much better nutritional choice. The readings (Ramos-Elorduy (1998) and Healthcare News (2011) ask the student to consider whether an insect based diet should be promoted in western countries. If we did, what would be the technological impediments toward making insects available as a dietary choice on a much broader scale?

Silk production has been an important part of Asian, European and American economies. All silk production takes place in culture as silk moths no longer survive in sufficient numbers in the wild. The requirement for silk farms to mass produce silk invites a variety of technological problems that range from microbial challenges in mass rearing programs to efforts to extract and store the silk. The interface between science and technology is examined in week 13 using the paper by Allen (1999).

Learning Outcome 4: Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address the problems

of the contemporary world.

Technology holds the key to fixing a variety of human psychological problems involving insects. Entomophobia can be fairly easily treated and ameliorated with behavioral therapies. However, delusional parasitosis presents a problem of a different magnitude. Psychoactive drugs are largely ineffective as are virtually all other traditional therapies. Can technology help? We look at the prospects in week 7 with the article by Pemberton (1999).

There are nearly 100 references to insects in monotheistic religious texts. Why? Insects also appear routinely in music, art, literature and poetry where their function can be literal, allegorical or metaphorical. Why are insects such a rich source of inspiration? We use the species scope concept to make sense of this. Readings relevant to this undertaking are listed in Week 3.

Insects figure prominently in the human psyche because the ability of insects to vector deadly diseases to humans has been important determining the outcome of historical events. There are many examples from which to choose but the Black Death stands out as pivotal. The biology is compelling both when considered from the standpoint of medieval medicine and our modern understanding. We ask the student to consider how ancient people made sense of the plague. How did the failure of key professionals to stop the plague affect society? What is the potential for plague in modern times and what are the variables that would impact our response. The readings from Stassler (1998), Campbell (1921) and Wikipedia in week 4 cover various aspects of the problem.

B) How do the topics address the GE category expected learning outcomes?

Learning Outcome 1: **Students will understand the basic facts, principles , theories and methods of modern science.**

Students will:

Understand the role of insects in establishing key biological theories such as the Germ Theory of Disease and the Modern Synthesis. Many lectures have biological theories in them as part of the discussion. For instance, we discuss basic Mendelian genetics in lecture 15 in learning about insect resistance to insecticides resulted in the miracle insecticide, DDT, becoming useless. Darwinian evolution is a recurring theme in many lectures as well. However, there are two lectures (25, 26) that are devoted entirely to the explication of important scientific theories and how research done on insects was pivotal to their establishment;

Understand the biological facts behind key components of insect physiology, morphology and the nervous system……Basic entomology is a recurring theme throughout all lectures. However, these concepts are specifically highlighted in lectures 4, 5 ,6, 21 and 22. In addition the impact of basic entomology on human affairs is 3 ,5, 7, 9, 11, 12, 13 and 14;

Develop testable, falsifiable hypotheses to explain how insects impact the world. Although hypothesis testing is generally the province of the laboratory, there are occasions in lecture in which it becomes important. Once such occasion is in the lectures on how insects circumscribed Napoleon's imperialistic ambitions (lectures 12, 13 and 14). The common view of history is that Napoleon was defeated by many factors of which insect-borne disease may have been one.

Students will be repeatedly asked to explain what kind of evidence would have to be adduced to support insect-borne disease hypothesis as a major cause of Napoleon's downfall. In addition, there are numerous occasions in lectures 25 and 26 to discuss the nature of science and how experimental work was the backbone of discovering the Germ Theory of Disease (lecture 25) and the biological source of variation leading to the Modern Synthesis (lecture 26).

Learning Outcome 2: Students will understand key events in the development of science and recognize that science is an evolving body of knowledge.

Learning Objectives for Learning Outcome 2:

Students will:

Explore how the human desire to explain the natural world evolved from mythology to religion to science… Lectures 2 and 3 develop this theme. Students will be asked to identify how human thought on the origin of the earth and human beings were depicted by ancient people. One inescapable conclusion is that insects were over-represented in explaining these phenomena. Why are insects so often used to explain both human origins and the origin of the universe? Here we introduce the species-scape concept and use it to explain the importance of insects as literal representations of the natural world as well as metaphorical and allegorical sign posts of ideas that are important to humans;

Understand why efforts to control insects went through distinct eras that changed from prayers to insecticide use……Two lectures (15 and 16) cover the evolution of pest control from wishful thinking and divine supplication to the advent of chemical insecticides during WWII and the aftermath where chemicals used successfully in wartime were redeployed in agriculture and in world health campaigns. DDT is an exemplar of what happened next. Although hailed by Sir Winston Churchill as "the miraculous powder" and unquestionably changed the course of WWII, DDT was derided as "the elixir of death" by Rachel Carson in recognition of its environmental effects. The evolution of insect resistance to insecticides sealed DDT's faith, leading to the cancellation of its registration in 1970. The pesticide industry turned to other classes of chemicals, some of which survive today, to keep the industry going.

Understand the biology of using insects in medicine from ancient to modern practices….. We begin with an examination of the Doctrines of Signatures (Pliny the Younger) and progress through two millennia of using insects to treat disease (lectures 18, 23). Finally, the human genome project has allowed us to screen for genes that are common to insects and other organisms of interest, including insects. New was of designing drugs, based on arthropod venoms, has given new hope for therapeutic drugs that can fight even the most recalcitrant human diseases (lecture 24).

Learning Outcome 3: Students will describe the inter-dependence of scientific and technological developments.

Learning Objectives for Learning Outcome 3:

Students will:

Examine the use of insects as weapons of war by investigating ancient to modern practices, focusing on technological aspects of incorporating insects into biological weapons. This theme runs through lectures 12, 13 and 14. While ostensibly directed at understanding why Napoleon didn't take over the world, it is an occasion for understanding how technology advanced certain causes, e.g., making it possible to host and arm a standing army and to send it far afield in quest of the emperor's goals but which was miserably lacking in other respects. There was no understanding, yet, that microbes caused disease and, consequently, no way to treat them. There was no way to deal with the human health issues occasioned by holding 1000's of soldiers in wretched conditions with poor sanitation, too little food and a lack of native resistance to endemic pathogens. The combination of these factors lead to disaster after disaster--- particularly when insect vectors could be counted on to transport pathogens efficiently from host to host in crowded conditions.

Understand the psychology, nutritional analytics and technological impediments to using insects as a food source……Lectures 20, 21 and 22 take up the issues of promoting entomophagy on a global basis. First stop is to understand the psychology and why eating insects is perfectly acceptable elsewhere in the world, ancient and modern, but is truly anathema to westerners despite a fondness for shrimp and lobster. Next, we perform a nutritional analysis to demonstrate that if you're interested in a low fat, high protein diet, insects are the way to go. Then, we look at energy flow through food chains and how that would be impacted , on a global basis, if humans ate crickets instead of cows. The final element to the discussion is to examine technological impediments to implementing a global entomophagy program.

Investigate the interaction between microbiology and the machinery needed for silk production, lecture 22. The only place that silk moths breed is in culture. However, maintaining both a parasite-free silk moth culture and designing equipment that will successfully unravel silk, which is produced by the insect in a single strand, is daunting. We look at how these technological challenges were overcome and why silk from cultures is demonstrably superior to silk obtained from wild sources.

Learning Outcome 4: Students will recognize social and philosophical implications of scientific discoveries and the potential of science and technology to address human problems.

Learning Objectives for Learning Outcome 4:

Students will:

Understand the neurobiology of fear of insects and potential for treatment. In lectures 7 and 8, students will study what happens when insects invade our fears and our dreams. What is the evolutionary explanation for fear of insects? What are the events in the nervous system that take place when we are faced with a scary thing with lots of legs? Does the neurobiology suggest some pathways for treatment? Differences in fear states from entomophobia to delusionary parasitosis are examined. The representations of insects in dreams are also explored.

Be able to explain why insects repeatedly appear in divine texts, music, literature and poetry. IS this simply a case of proximity? Or does it speak to both our sense of wonder and our fear of creatures which can cause us harm but, at the same time, can explain so much about the world?

Articulate the effects of the bubonic plague and other insect-borne diseases on society…..Throughout human history, insects have appeared as harbingers of death owing to their capacity to vector disease. From representations of flies as Beelzebub in the Bible to the medieval scourge known as the Black Death, insects repeatedly have played the role of evil. How have human beings coped with this persist threat? How have technological advances affected this view? What kind of role will insects play in the future either as sources and distributors of pathogens or biological weapons? These issues are examined in lectures 9 and 11.

C) How do the written assignments address the GE category expected learning outcomes?

The written assignments for Entomology 2101appear below along with an explanation of how each addresses the expected learning outcome:

1. There are four graded laboratory exercises:
   Week 2—creating an insect myth to explain some biological principle. This exercise is consistent with learning outcomes 1 and 2. The best way to instruct a student in important scientific principles is to ask them to explain one. This assignment will do that and ask the student to bring his or her creativity to bear in the process. Secondly, students will have to indicate where on the evolutionary trajectory from myth to religion to science their idea falls and why this is so.

   Week 3—students will watch an insect-based horror film and compose a written analysis whether the entomological information was accurate or not. This written assignment will explicate the facts of entomology, a component of learning outcome 1.

   Week 7—students will procure information about entomophagy in current societies around the world and compare the nutritional value of insect consumption to a typical western diet. Students will write an analysis that explains the benefits to humans of an insect-based diet as well as the energy investment needed to produce both the western diet and an insect/'based one. They will be asked to explain the significance of their analysis to food security in a climate-challenged world. This assignment addresses learning outcomes 3 and 4.

   Week 8—Students will analyze religious texts drawn from the Torah, the Bible and the Quran to discern which orders or families of insects it is permissible to eat in each religion. Then, students will be asked to address the biological basis, if any, for each prohibition. Finally, students will be asked to explain and resolve whether or not the Bible commits a biological error by suggesting that locusts have four legs and what this portends for biblical literalism. Collectively, this assignment addresses learning outcomes 1 and 4.

2. Students are required to complete a semester-long project on a subject of their choosing. There are 3 components to this assignment: a physical manifestation of their topic; a written 10 page paper and an oral presentation. The written paper could potentially address any of the four learning outcomes depending on which topic each student chooses and how they decide to put their project together. Each project will address at least one learning outcome and could potentially address more than one.

D) How do the prerequisites provide and appropriate level of preparation for the course? There are no prerequisites for this course. The only prerequisite we considered was a basic entomology course. However, since sequences are no longer required, we decided to embed the necessary basic entomology into lectures or labs so that students could take Entomology 2101 as a stand-alone course.

E) What types of laboratory experiences will the students have in this course. The laboratory for this course is richer in format than a typical science course. We will, of course, have standard laboratory experiences in which the students is asked to read some material, identify a testable hypothesis and proceed with an experiment that will test that hypothesis. There will also be a significant data analysis component to these labs. Examples of this type of laboratory are weeks4, 5 6 and 10. During other laboratories, however, the experience will be more observational (weeks 2,7 and 9). Here again, students will be presented with an entomological problem, be asked to read relevant literature and then propose an hypothesis to explain the phenomenon. Thereafter, students will be presented with a variety of either live or preserved specimens to gather data to refute or support their hypothesis. In weeks 3 and 8, students will have a third kind of experience. They will be asked to evaluate biological phenomena through a cultural lens and evaluate whether the cultural result is faithful to science. While this may sound a bit unusual, it is actually one of the more important things we can do in this course. Students misapply and misinterpret science all the time. This type of lab is designed to get them to think about what is evidence based and what is a matter of opinion.