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MAR 16 2015

OFFICE OF THE SENATE COUNCIL

1. General Information

1a. Submitted by the College of: AGRICULTURE, FOOD AND ENVIRONMENT

Date Submitted: 9/15/2014

1b. Department/Division: Agricultural Biotechnology

1c. Contact Person

Name: Charles Fox

Email: cfox@uky.edu

Phone: 859-257-7474

Responsible Faculty ID (if different from Contact)

Name:

Email:

Phone:

1d. Requested Effective Date: Semester following approval

1e. Should this course be a UK Core Course? No

2. Designation and Description of Proposed Course

2a. Will this course also be offered through Distance Learning?: No

2b. Prefix and Number: ABT 505

2c. Full Title: Evolution in Agriculture, Medicine and Conservation Biology

2d. Transcript Title: Evolution in Ag, Med and Conserv

2e. Cross-listing: ENT 505

2f. Meeting Patterns

LECTURE: 3

2g. Grading System: Letter (A, B, C, etc.)

2h. Number of credit hours: 3

2i. Is this course repeatable for additional credit? No

If Yes: Maximum number of credit hours:

If Yes: Will this course allow multiple registrations during the same semester?

2j. Course Description for Bulletin: An introduction to modern evolutionary theory with emphasis on its application to current problems in agriculture, the biomedical sciences, and conservation biology.

2k. Prerequisites, if any: Genetics (ABT 360, BIO 304 or equivalent introductory genetics course)

2l. Supplementary Teaching Component:

3. Will this course taught off campus? No

If YES, enter the off campus address:

4. Frequency of Course Offering: Fall,

Will the course be offered every year?: Yes

If No, explain:

5. Are facilities and personnel necessary for the proposed new course available?: Yes

If No, explain:

6. What enrollment (per section per semester) may reasonably be expected?: 10-20

7. Anticipated Student Demand

Will this course serve students primarily within the degree program?: No

Will it be of interest to a significant number of students outside the degree pgm?: Yes

If Yes, explain: We expect many students in Biology or other biological sciences majors to be interested in this course.

8. Check the category most applicable to this course: Relatively New – Now Being Widely Established,

If No, explain:

9. Course Relationship to Program(s).

a. Is this course part of a proposed new program?: No

If YES, name the proposed new program:

b. Will this course be a new requirement for ANY program?: No

If YES, list affected programs:

10. Information to be Placed on Syllabus.

a. Is the course 400G or 500?: Yes

b. The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from **10.a** above) are attached: Yes

Distance Learning Form

Instructor Name:

Instructor Email:

Internet/Web-based: No

Interactive Video: No

Hybrid: No

1.How does this course provide for timely and appropriate interaction between students and faculty and among students? Does the course syllabus conform to University Senate Syllabus Guidelines, specifically the Distance Learning Considerations?

2.How do you ensure that the experience for a DL student is comparable to that of a classroom-based student's experience? Aspects to explore: textbooks, course goals, assessment of student learning outcomes, etc.

3.How is the integrity of student work ensured? Please speak to aspects such as password-protected course portals, proctors for exams at interactive video sites; academic offense policy; etc.

4.Will offering this course via DL result in at least 25% or at least 50% (based on total credit hours required for completion) of a degree program being offered via any form of DL, as defined above?

If yes, which percentage, and which program(s)?

5.How are students taking the course via DL assured of equivalent access to student services, similar to that of a student taking the class in a traditional classroom setting?

6.How do course requirements ensure that students make appropriate use of learning resources?

7.Please explain specifically how access is provided to laboratories, facilities, and equipment appropriate to the course or program.

8.How are students informed of procedures for resolving technical complaints? Does the syllabus list the entities available to offer technical help with the delivery and/or receipt of the course, such as the Information Technology Customer Service Center (http://www.uky.edu/UKIT/)?

9.Will the course be delivered via services available through the Distance Learning Program (DLP) and the Academic Technology Group (ATL)? NO

If no, explain how student enrolled in DL courses are able to use the technology employed, as well as how students will be provided with assistance in using said technology.

10.Does the syllabus contain all the required components? NO

11.I, the instructor of record, have read and understood all of the university-level statements regarding DL.

Instructor Name:

SIGNATURE|LGRABAU|Larry J Grabau|ABT 505 NEW College Review|20140926

SIGNATURE|JMETT2|Joanie Ett-Mims|ABT 505 NEW Undergrad Council Review|20141210

SIGNATURE|ZNNIKO0|Roshan Nikou|ABT 505 NEW Graduate Council Review|20150316

Courses | Request Tracking

New Course Form

https://myuk.uky.edu/sap/bc/soap/rfc?services=

Open in full window to print or save

Generate R

Attachments:

Browse... Upload File

	ID	Attachment
Delete	3525	Review sheet.pdf
Delete	3703	New course letter.pdf
Delete	3706	Letter from Entomology.pdf

First 1 2 Last

Select saved project to retrieve... Get New

(*denotes required fields)

1. General Information

a. * Submitted by the College of: AGRICULTURE, FOOD AND ENVIRONMENT Submission Date: 9/15/2014

b. * Department/Division: Agricultural Biotechnology

c.

* Contact Person Name: Charles Fox Email: cfox@uky.edu Phone: 859-257-7474

* Responsible Faculty ID (if different from Contact) Email: Phone:

d. * Requested Effective Date: ◉ Semester following approval OR ○ Specific Term/Year [1]

e.

Should this course be a UK Core Course? ○ Yes ◉ No

If YES, check the areas that apply:

☐ Inquiry - Arts & Creativity	☐ Composition & Communications - II
☐ Inquiry - Humanities	☐ Quantitative Foundations
☐ Inquiry - Nat/Math/Phys Sci	☐ Statistical Inferential Reasoning
☐ Inquiry - Social Sciences	☐ U.S. Citizenship, Community, Diversity
☐ Composition & Communications - I	☐ Global Dynamics

2. Designation and Description of Proposed Course.

a. * Will this course also be offered through Distance Learning? ○ Yes [4] ◉ No

b. * Prefix and Number: ABT 505

c. * Full Title: Evolution in Agriculture, Medicine and Conservation Biology

d. Transcript Title (if full title is more than 40 characters): Evolution in Ag, Med and Conserv

e. To be Cross-Listed [2] with (Prefix and Number): ENT 505

f. * Courses must be described by at least one of the meeting patterns below. Include number of actual contact hours[3] for each meeting pattern type.

3	Lecture		Laboratory[1]		Recitation		Discussion
	Indep. Study		Clinical		Colloquium		Practicum
	Research		Residency		Seminar		Studio
	Other	If Other, Please explain:					

g. * Identify a grading system:

◉ Letter (A, B, C, etc.)
○ Pass/Fail
○ Medicine Numeric Grade (Non-medical students will receive a letter grade)
○ Graduate School Grade Scale

h. * Number of credits: 3

i. * Is this course repeatable for additional credit? ○ Yes ◉ No

If YES: Maximum number of credit hours:

If YES: Will this course allow multiple registrations during the same semester? ○ Yes ○ No

j. * Course Description for Bulletin:

An introduction to modern evolutionary theory with emphasis on its application to current problems in agriculture, the biomedical sciences, and conservation biology.

k. Prerequisites, if any:

Genetics (ABT 360, BIO 304 or equivalent introductory genetics course)

l. Supplementary teaching component, if any: ○ Community-Based Experience ○ Service Learning ○ Both

3. * **Will this course be taught off campus?** ○ Yes ◉ No

If YES, enter the off campus address:

4. **Frequency of Course Offering.**

a. * Course will be offered (check all that apply): ☑ Fall ☐ Spring ☐ Summer ☐ Winter

b. * Will the course be offered every year? ◉ Yes ○ No

If No, explain:

5. * **Are facilities and personnel necessary for the proposed new course available?** ◉ Yes ○ No

If No, explain:

6. * **What enrollment (per section per semester) may reasonably be expected?** 10-20

7. **Anticipated Student Demand.**

a. * Will this course serve students primarily within the degree program? ○ Yes ◉ No

b. * Will it be of interest to a significant number of students outside the degree pgm? ◉ Yes ○ No

If YES, explain:

We expect many students in Biology or other biological sciences majors to be interested in this course.

8. * **Check the category most applicable to this course:**

☐ Traditional – Offered in Corresponding Departments at Universities Elsewhere
☑ Relatively New – Now Being Widely Established
☐ Not Yet Found in Many (or Any) Other Universities

9. **Course Relationship to Program(s).**

a. * Is this course part of a proposed new program? ○ Yes ◉ No

If YES, name the proposed new program:

b. * Will this course be a new requirement [5] for ANY program? ○ Yes ◉ No

If YES [5], list affected programs::

10. **Information to be Placed on Syllabus.**

a. * Is the course 400G or 500? ◉ Yes ○ No
If YES, the *differentiation for undergraduate and graduate students must be included* in the information required in **10.b.** You must include: (i) ident additional assignments by the graduate students; and/or (ii) establishment of different grading criteria in the course for graduate students. (See SR

b. ☑ * The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if appl **10.a** above) are attached.

[4] Courses are typically made effective for the semester following approval. No course will be made effective until all approvals are received.
[5] The chair of the cross-listing department must sign off on the Signature Routing Log

[1] In general, undergraduate courses are developed on the principle that one semester hour of credit represents one hour of classroom meeting per week for a semester, exclusive of any laboratory meeting. Laboratory meeting, generally, re two hours per week for a semester for one credit hour. (from SR 5.2.1)
[2] You must also submit the Distance Learning Form in order for the proposed course to be considered for DL delivery.
[3] In order to change a program, a program change form must also be submitted.

Rev 8/09

Submit as New Proposal Save Current Changes

Gen 300
Outline of topics
Spring 2014

(Note: this is the review sheet handed out to students for the "trial" version of the course offered as Gen 300 in Spring 2014.)

Exam 1

- What is evolution
- History of evolutionary thought
  - Darwin's influences
  - Darwin's main ideas in The Origin of Species
  - Alfred Russell Wallace
  - The modern synthesis
- Naturalistic fallacy
- Proximate vs ultimate causality
- Anthropomorphizing
- Variation in Nature
  - Mutation
    - Mutations are generally rare
    - Most mutations have either no effect or are deleterious
    - Mutations occur at random:
  - Recombination
  - Gene Flow
- Measuring genetic variation within populations
  - Polymorphism vs monomorphism
  - Visible polymophism
  - Electrophoretic variation
    - Allozymes
  - DNA variation
- Quantitative traits
- Clines
- Extranuclear inheritance
  - Uniparental inheritance
    - Maternal inheritance
    - Maternal effect
    - Inheritance of mitochondria/plastids
      - Chloroplast sorting and leaf variegation
      - Inheritance of microorganisms
        - Sex-ratio distortion
        - Cytoplasmic incompatibility
- Epigenetic inheritance
  - Genomic imprinting
- Hardy-Weinberg Equilibrium
  - Assumptions of Hardy-Weinberg
  - Linkage disequilibrium
  - Sex-linkage
- Quantitative trait variation
  - Polygenic
    - Metric traits
    - Meristic traits
  - Quantitative genetics
  - Why traits are normally distributed
    - Central limit theorem
  - Threshold Traits
- Modeling quantitative traits
  - $P = G + E = A + D + I + E$
  - $V_P = V_G + V_E = V_A + V_D + V_I + V_E$
  - Additive genetic effects
  - Dominance
  - Heritability
    - Broad sense (H^2)
    - Narrow sense (h^2)
- Metapopulations
  - Demes
- Genetic Drift
  - Effect of p and N on genetic drift
  - Fixation of alleles
    - Probability any specific allele is fixed
  - Consequences of genetic drift
    - Alelle frequencies
    - Heterozygosity
  - Effective population size (N_e)

- Factors that cause $N_e < N$
- Population bottleneck
- Founder effect
- Neutral Theory of Molecular Evolution
- Coalescence
  - Mitochondrial Eve

Population structure
- F-statistics
  - Fixation index (F_{ST})
    - $F_{ST} \approx 1 / (4Nm + 1)$ at equilibrium
  - Inbreeding coefficient (F_{IS})
  - F_{IT}
- Gene flow
  - N, m, and Nm
    - $Nm > 1$ vs $Nm < 1$
  - Measuring gene flow
  - Direct vs indirect measures
  - Nm
- Human population structure
  - Concepts of race
  - Skin color

Inbreeding
- A population is considered inbred when F > expected in a panmictic population
- Inbreeding coefficient
- Consequences on inbreeding
  - Heterozygosity
- Inbreeding depression
  - Causes of inbreeding depression
    - Recesive deleterious alleles
    - Overdominance
  - Genetic load
    - Purging of the genetic load
- Outcrossing depression
  - Optimal outcrossing distance

Exam 2

Natural selection
- Kin selection

Fitness
- Absolute fitness
- Relative fitness
- Coefficient of selection

Adaptive landscape

Forms of selection
- Directional selection
  - Effects of dominance/ recessiveness on selection response
- Stabilizing selection
  - Overdominance
- Disruptive selection
  - Underdominance

Balancing selection
- Overdominance vs underdominance
- Frequency dependence (negative vs positive frequency dependent selection)

Relative effects of selection vs drift

Genetic hitchhiking
- Selective sweep

Signatures of selection
- Tests for selective sweeps
- d_N/d_S
  - Purifying selection (negative selection)
  - Positive selection

Selection on the human genome

Selection on quantitative traits
- Stabilizing selection
- Disruptive selection
- Directional selection
  - Breeders' equation
    - $R=h^2S$
    - Selection differential
- Artificial selection
  - Asymmetrical responses
  - Selection plateaus
  - Selection on breeding values
  - Genomic selection
- Correlated responses to selection

- Genetic correlations
- Detecting selection on human quantitative traits

Harvesting wild organisms
- Effects on organism ecology → selection on harvested and non-harvested species
- Trait-specific harvesting
  - Coat color, shell patterns
  - Behavioral traits
  - Trophy hunting
  - Size-selective predation
- Evolution in commercial fisheries
  - Size/age-specific harvesting
  - Atlantic cod
    - Evolution in cod
    - Why aren't cod recovering?
  - Proposed solutions to harvest-induced evolution
  - Evolution in farmed fish
    - Effects on natural populations

Ecological vs evolutionary time
- Eco-evolutionary dynamics

Phylogeny
- Topology of a tree
- Nodes of a tree
- Common ancestors
- Interpreting a phylogeny
- Scaled vs unscaled trees
- Rooting a tree
- Cladistic classification
  - Monophyletic groups
  - Paraphyletic groups
  - Polyphyletic groups
    - Convergent evolution

Using phylogenies to test evolutionary hypotheses
- Map evolutionary transitions
  - Reconstruct ancestral characters states
  - Parsimony
- Distinguishing shared evolutionary history from convergent evolution
  - Color vision in primates
- Testing ecological hypotheses
  - Independent contrasts
  - Mating behavior and white blood cells in primates
- Testing coevolutionary hypotheses
  - Phylogentic congruence (concordant phylogenies)
- Phylogeography
  - Identifying geographic origins of traits/organisms
  - Domestication of pigs
  - Geographic origins of corn
  - Origin of H7N9
  - Origin of HIV
  - Medical forensics
- Conservation biology
  - Conserving phylogentic diversity
  - Identifying conservation targets

Exam 3

Reconstructing evolutionary history
- Phenetic vs Cladistic methods
- Synapomorphy
- Homoplasy
- Parsimony
- Consensus trees
  - Polytomy
- Molecular clocks
- Gene trees vs species trees

Covolution
- Specific vs diffuse coevolution
- Gene-for-gene models
  - Resistance vs virulence (avirulence) genes
  - Evolutionary cycles
    - Stable vs unstable cycles
    - Fluctuating polymorphism
  - Hessian fly example
- Matching alleles model
- Evolutionary arms races
  - Red queen
  - Rock-paper-scissors model

- Evolution of virulence
  - Pathogenicity
  - Optimal virulence model
  - Factors affecting virulence evolution
    - Mode of transmission
    - Genetic variation among hosts
    - Host population density
    - Infections by multiple genotypes → intraspecific competition
    - Interspecific competition (microbial wars)
    - Spatial structure
    - Opportunistic parasites
- Evolution of vertebrate immunity
  - Innate immunity
  - Adaptive (acquired) immunity
  - Humoral vs cellular immunity
  - V(D)J recombination and antibody diversity
  - Clonal selection/expansion
  - Primary vs secondary immune response
  - Somatic hypermutation
- Evolution in HIV
  - HIV life cycle
  - Source of genetic variation in HIV
    - Very high mutation rate
    - Recombination
  - CTL escape
  - Drug resistance in HIV
- Evolution of antibiotic resistance
  - Multidrug resistance
    - Mechanisms of inheritance (e.g., R-plasmids, efflux pumps)
  - Source of resistance genes
  - Horizontal gene transfer
  - Selection on resistance genes
  - Evolutionarily-informed management
- Vertically-inherited microorganisms
  - Wolbachia
  - Cytoplasmic incompatability
  - Gene drive strategies
- Herbivory
  - Tolerance
    - Why aren't all plants tolerant of herbivory?
  - Resistance
    - Constitutive resistance
    - Induced resistance
    - Why aren't all plants resistant to herbivores?
- Bt case study
  - Cry toxins
  - Evolution of resistance to Bt
  - Managing insect resistance to Bt
    - Insect resistance management (IRM)
    - Refuges
    - Inheritance of resistance
    - High dose/refuge strategy
    - Cost of resistance
    - Cross resistance
- Herbicide resistance
  - Glyphosate resistance
    - Evolution of resistance
    - Cost of resistance
    - Managing resistance evolution
- Transgene flow

Final exam

- Life history evolution
  - Life history traits
  - Trade-offs
    - Allocation trade-offs
    - Genetic correlations
  - Offspring size versus number
  - Car-house paradox, resource availability and acquisition
  - Demography
    - Life tables
      - Age-specific survivorship (l_x)
      - Age-specific fecundity (m_x)
      - Survivorship curves
    - Population growth rates
      - Net reproductive rate (R_0)
      - Intrinsic rate of increase (r)

- Relationship between fitness and R_0/r
- Reproductive value
- Evolution of human pygmies

Senescence
- Why do organisms senesce
  - Decline in selection with age
    - Mutation accumulation
    - Antagonistic pleiotropy
      - Cost of reproduction
  - Extrinsic mortality
  - Menopause
    - Mother hypothesis
    - Grandmother hypothesis
    - Reproductive competition
      - Pre-industrial Finns
  - Sex-differences in mortality
    - Sexual selection
      - Anisogamy
      - Sexual conflict
      - Monogamy and rates of aging
  - Aging in clonal organisms
  - Aging in modular organisms

Evolutionary conservation biology
- Conservation genetics
- Evolution vs phenotypic plasticity
  - Breeding date in birds
- Evolution in responses to climate change
- Evolutionary rescue
  - Limits to evolutionary responses
  - Facilitating evolutionary rescue
  - Genetic rescue
- Invasive species
  - Who invades
  - Time lags in invasion
  - Bottlenecks and invasiveness
  - Evolution of native species

End of class

UNIVERSITY OF KENTUCKY

College of Agriculture

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Thank you for considering this new proposal for a new course, ABT/ENT 505, titled "Evolution in Agriculture, Medicine and Conservation Biology." This course has been reviewed and approved by the ABT advisory committee, the Director of ABT, Dan Howe, the Department of Entomology faculty, and the Chair of the Department of Entomology.

This new course is intended to be an *elective* primarily serving ABT majors, but also of interest to students in Biology and some of the other majors in the biological science (e.g., NRC), plus ENT graduate students.

This course fills a fairly unique niche on campus in that it is focused on applied evolutionary biology, but geared towards students that have substantial background in biology and genetics. There are some courses that overlap with this course; these are:

- Biology 303, "Evolution" – This course will overlap in the basic concepts examined, but the proposed course will be taught at a higher level and will be much more focused on applied problems of interest to students in agriculture and medicine.
- Biology 508, "Evolution" – This course is, based on course descriptions, learning objectives and level of presentation, the closest in overlap to the proposed course. However, the proposed course will differ in a couple ways. First, BIO 508 is much more focused on evolutionary history (which makes up only ~4-5 lectures in the proposed course) and more focused on molecular evolution (the new course will cover molecular evolution, but not in the depth it is covered in 508). BIO 508 is not focused on applied problems, whereas the proposed course will spend about half of our time on applied problems. Students who take both courses will experience reasonable overlap in the topics covered, but probably >50% of the material will be unique in the two courses.
- Biology 425, "Biology Seminar: Evolutionary Medicine" – This seminar has been taught by Craig Sargent a few times, and will likely be taught in the future. However, this is a one credit seminar, and overlaps only a little with the proposed course.
- Agricultural Biotechnology (ABT) 461, "Population genetics". Population genetics is the foundation for much of evolutionary biology, so it is necessarily the case that there will be some overlap between ABT 461 and the proposed course. We estimate that ~25-30% of the concepts covered in the proposed course have also been covered in ABT 461, although the proposed course covers this information at an advanced pace and, for many concepts, with a different perspective. We considered whether it is practical to make ABT 461 a prerequisite for the proposed course, but this is impractical because (a) most students take ABT 461 in spring of their senior year, making it impossible for them to also take the proposed course if 461 were a prerequisite for the proposed course, and (b) we hope to recruit a significant number of students from outside ABT (from BIO, other Ag majors, and/or from the

College of Medicine programs), few if any of whom will have taken population genetics or an equivalent.

- Physiology (PGY) 512, "Evolutionary Medicine" – This is a course geared towards introducing physiologist to basic concepts in evolutionary biology and how they can provide new insights into our understanding of physiology and disease. It differs from the proposed course in that the proposed course, for lack of a better term, the proposed course will be a much more hardcore evolutionary biology course, and will focus much less on medicine and much more on agriculture and conservation biology.

The proposed course thus overlaps only slightly with courses that currently exist on campus, and covers a variety of topics in applied evolutionary biology that are not covered by other courses on campus.

Note also that we offered a version of this course (as GEN 300) this past spring semester. The course had only a few students (we did not advertise, as it was intended to be a "trial" of the new course). However, those that took it were happy with the course; it received an average of 3.5 (out of four) for both "value of the course" and "quality of teaching".

Sincerely,

Dr. Charles Fox, Professor and Director of Graduate Studies

Dr. Daniel Howe, Professor and Director of the Agricultural Biology program

Subject: Entomology Faculty approve cross listing of ABT 505 and ENT 505
From: "Obrycki, John" <John.Obrycki@uky.edu>
Date: 9/15/2014 4:13 PM
To: "Grabau, Larry" <larry.grabau@uky.edu>
CC: "Fox, Charles W" <cfox@email.uky.edu>

Date: September 15, 2014

To: Larry Grabau, Associate Dean for Academic Programs

Re: Cross listing ABT 505 and ENT 505

From: John Obrycki, Chair, Department of Entomology

The members of the faculty in the Department of Entomology unanimously approved cross listing ABT 505 with ENT 505 at our faculty meeting on September 15, 2014.

John J. Obrycki
Professor and Chair
Department of Entomology
University of Kentucky
Lexington, KY 40546 USA
PH: 859-257-7450
FAX: 859-323-1120
E-mail: john.obrycki@uky.edu

Ellis, Janie

From: Nikou, Roshan
Sent: Monday, March 16, 2015 10:00 AM
To: Brothers, Sheila C; Carvalho, Susan E; Ellis, Janie; Ett, Joanie M; Hippisley, Andrew R; Jackson, Brian A; Lindsay, Jim D.; Nikou, Roshan; Price, Cleo; Timoney, David M
Cc: Fox, Charles W; Yu, Guoqiang; Wilson, John; Studts, Jamie L; Yeager, Kevin; Anastacio, Enrique &
Subject: Transmittals
Attachments: PLS 455G.pdf

TO: Andrew Hippisley, Chair and Sheila Brothers, Coordinator
Senate Council

FROM: Brian Jackson, Chair and Roshan Nikou, Coordinator
Graduate Council

Graduate Council approved the following proposals and is now forwarding them to the Senate Council to approve. Please note, the Graduate Council received the attached course proposal, PLS 455G via email.

Courses

ABT 505 Evolution in Agriculture, Medicine & Conservation Biology
BME 580 Introduction to Biomedical Imaging
MFS 503 Lean Manufacturing Principles & Practice
BSC 732 Interdisciplinary Protocol Development
PLS 455G Wetland Delineation
EES 579 Groundwater Geophysics

Roshan Nikou
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