Course Change Request

New Course Proposal

Date Submitted: 09/20/21 11:19 am

Viewing: BIOL 638 : Sensory Ecology

Last edit: 09/20/21 11:19 am

Changes proposed by: dpolayes

Are you completing this form on someone else's behalf?

No

In Workflow

1. **BIOL Graduate Representative**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Graduate
5. Registrar-Courses
6. Banner

Approval Path

1. 09/20/21 9:59 pm Iosif Vaisman (ivaisman): Approved for BIOL Graduate Representative

Effective Term: Fall 2022

Subject Code: BIOL - Biology

Course Number: 638

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Sensory Ecology

Banner Title: Sensory Ecology

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable: May only be taken once for credit (NR)
GRADUATE ONLY

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):
Biol508 Animal Communication

Recommended Corequisite(s):
Biol508 Animal Communication

Required Prerequisite(s) / Corequisite(s) (Updates only):

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:
Receiving and interpreting information is critical for life on Earth. However, determining how organisms (including plants, microorganisms, or vertebrates) interpret sensory information and act on it is challenging. By necessity this field focuses on quantification to avoid imposing our own biases, and therefore sensory ecology differentiates from other fields by having a mechanistic, bottom-up, approach. In this course we will study the mechanics of sensory reception, sensory perception,

and sensory processes that lead to decisions. Sensory information will be framed within a broader evolutionary context and how it is transmitted. Various sensory modalities and how organisms perceive and act on this information will be discussed.

Justification:

This class will broaden the selection of courses offered to students in the Integrative Biology PhD program, and its emphasis will focus on how to collect, analyze, and interpret their data. Students in these programs have varied research agendas involving plants, insects, and vertebrates. There is a growing interest in the student body to focus on behavior, interspecific interactions, the interface between organisms and the environment. A core understanding of sensory ecology is critical for all of these topics, but most importantly we need courses that will provide our students with the tools (technical, statistical, logistical) needed to properly design, execute, and analyze their own research, which this course provides.

Does this course cover material which crosses into another department? No

Learning Outcomes:

Students will be able to apply the principles of sensory ecology to design,execute, and analyze experiments.
Students will gain experience using equipment used in the field of sensory ecology, and demonstrate competence in their measurements. For example, students will learn the concepts of spectrophotometry and will be able to measure a number of surfaces with a limited degree of error (±5% reflectance).
Students will be able to re-analyze data obtained directly (own collection) or indirectly (e.g., from Dryad) and re-analyze datasets, including data manipulations, sensory space projections, and analysis.
Each student should be able to recall a variety of studies covering various aspects of sensory ecology, and summarize how various organism receive, perceive and process sensory information.

Attach Syllabus

Sensory Ecology-BIOL638.pdf

Additional Attachments

Staffing:

Dr. Daniel Hanley-Biology

Relationship to Existing Programs:

Needed for the growing number of graduate students interested in this field

Relationship to Existing Courses:

Unique course

Additional Comments:

Reviewer Comments

Key: 17309

Sensory Ecology: BIOL 638

Fall 2022 — Lecture room: TBD Tuesdays 4:30-7:10 PM
Office hours: Thursdays 4:30-5:30 PM

Instructor: Dr. Daniel Hanley — Email: dhanley2@gmu.edu
Phone: 703-993-1616 — Office: Colgan Hall 446/444

Course description:
Receiving and interpreting information is critical for life on Earth. However, determining how organisms (including plants, microorganisms, or vertebrates) interpret sensory information and act on it is challenging, since we bring our own sensory biases. Over the last three decades sensory ecology has emerged as a critical field, and has shaped our understanding of interspecific interactions. By necessity this field focuses on quantification to avoid imposing our own biases, and therefore sensory ecology differentiates from other fields like behavioral ecology by having a mechanistic, bottom-up, approach. In this course we will study the mechanics of sensory reception, sensory perception, and sensory processes that lead to decisions. We begin by framing sensory information within a broader evolutionary context and how sensory information is transmitted. We then will progress to learn about various sensory modalities in greater depth, and finally we will conclude with studying how organisms perceived and act on that information.

Course goals and objectives:
Students will be able to apply the principles of sensory ecology to design, execute, and analyze experiments. Students will gain experience using equipment used in the field of sensory ecology, and demonstrate competence in their measurements. For example, students will learn the concepts of spectrophotometry and will be able to measure a number of surfaces with a limited degree of error (±5% reflectance). Students will be able to re-analyze data obtained directly (own collection) or indirectly (e.g., from Dryad) and re-analyze datasets, including data manipulations, sensory space projections, and analysis. Each student should be able to recall a variety of studies covering various aspects of sensory ecology, and summarize how various organism receive, perceive and process sensory information.

Course structure:
Each lesson will cover a specific topic and will consist of lecture content, a focused paper discussion and an activity. These activities will typically involve our collecting or analyzing sensory information, related to the daily topic. This method of a general introduction, discussion, and practice is by design and will prepare you to execute your own experiments (see Projects). For each lesson there one shared reading assignment (see Schedule and Reading List). In addition, each week each student will choose one additional paper (, of their choosing, from the guided reading list. This will provide you with greater depth that will fuel our discussion, and will be related to our lecture content.

Prerequisites: Students would benefit from already haven taken Biol508 Animal Communication, or taking it alongside this course. This course will provide a solid, practical, grounding in sensory ecology, exploring how signals are produced and received. This course focuses on a bottom-up exploration on how animals acquire and process information.

Recommended Texts: I will provide you with all of the reading materials that you will need in PDF format. There is no need to purchase a textbook for this class. However, I do recommend two texts in addition to our reading list in case you want supplementary reading on these topics.

Dusenberry DB (1998) Sensory ecology: how organisms acquire and respond to information, W. H. Freeman and Company, New York, NY
Bradbury JW & Vehrencamp SL. Principles of animal communication by 2nd edition. Sunderland (Massachusetts): Sinauer Associates

Study partners: These are students in the class that you can call in case you miss class or need peer feedback.
1. _____ 2. _____
_____ _____
3. _____ 4. _____
_____ _____

Important Dates*:
Last day to add –
Last day to drop with full tuition refund –
Last day to drop with 50% tuition penalty –
Unrestricted withdrawal period (100% tuition penalty) –
Selective withdrawal period (100% tuition penalty) –

Useful Campus Resources: Writing Center: (703) 993-1200; http://writingcenter.gmu.edu
University Libraries: "Ask a Librarian" http://library.gmu.edu/mudge/IM/IMRef.html
Counseling and Psychological Services (CAPS): (703) 993-2380; http://caps.gmu.edu

Grading policies for Sensory Ecology
Your final grade will depend on your three quizzes, and a major research project that involves, a proposal, presentation, and a final research paper. This table (below) illustrates the contribution of each component to your final grade. All assignments will be distributed and assessed via Blackboard.

Quizzes: You will take three equally weighted quizzes. These will relate directly to the lecture content and required reading; however, may take a variety of forms including some multiple choice, short answer, essay questions or problem sets. These quizzes are intended to test your knowledge of course content at three distinct points throughout the course (see the schedule). These may contain content from anywhere within the course, not just the classes since the last quiz (i.e., this may partially cumulative). You will have 1 week to complete each quiz.

Homework: Your homework is intended to keep you on track for your major goals. For homework 1 you will receive full points if you have submitted a research topic with justification by the due date. For homework 2 you will be assessed based on your reference list for your topic. Your references must be peer reviewed research articles, and ~30 references, with 10 directly

related articles, is appropriate for this stage. You will turn in a reference list annotated with one sentence for each submitted reference, and will receive 0.20 points for each appropriate reference (guidance on acceptable articles will be provided in class). Homework 3 will consist of a draft paper, which may still be incomplete but will include revisions from your proposal and a clear progress toward your research paper. Clear progress would involve having collected measurements (i.e., secured data)

Research paper: Each student will be responsible for writing a scientific research paper. This paper must be relevant to sensory ecology; however, you will have a great deal of latitude on what subject you adopt for this paper, and my preference would be a topic that can advance your thesis, dissertation, degree requirements, or professional goals. This major project will be subdivided into three major, separately assessed, components. These will be a project proposal, a presentation, and a final paper. This paper is intended to give you a measurable return on investment. Please begin discussing potential paper topics with me early in the semester. Collaboration is fine, as long as author contributions are clearly articulated and assessable (guidance will be provided on the first class).

What happens if your research topic changes mid semester? The course is structured so that this can be avoided or accommodated. Each of the major assignments related to research are separate, parts of a whole. Therefore, if you need to change your focus, you can repurpose what you previously learned and present it concisely and effectively. Don't worry, I will help you!

Research proposal: Each student will propose an achievable research project that will run the course of the semester. Your proposal should outline the scope of your project and how it fits within the field of sensory ecology (at a level appropriate for this portion of the semester). A proposal will include a Summary, General Introduction, Methods, Expected Results, Significance, as well as a complete (it can expand) citation list. We will need to coordinate early on to ensure you are on-track, and this is your homework (see below).

Research presentation: You will be expected to present your research project to an audience of your peers. This 10-minute presentation should integrate your topic into the field generally by addressing why your research is important (referencing the General Introduction and Significance from your Project Proposal). Your research presentation will be evaluated based on your ability to describe your research, but also the presentation of your data. Guidance will be provided throughout the lessons on how sensory information can most effective displayed. This will take the place of a Final Exam and will be presented to the entire class

Assignment	Percentage of total grade
Quiz 1	5
Quiz 2	5
Quiz 3	5
Homework 1	5
Homework 2	5
Homework 3	5
Research proposal	20
Research presentation	20
Research Paper	30
Total	**100**

Grade calculation: Your final grade (%) will be converted to a GPA according to the table to the right. Please note, graduate students will likely want to ensure their GPA is higher than 3.00 (dashed line). Further information is provided in AP.3.2 (link in table footer).

Minimum Grade (%)	Letter Grade	GPA[1]
97	A+	4.00
93	A	4.00
90	A-	3.67
87	B+	3.33
83	B	3.00
80	B-	2.67
70	C	2.00
0	F	0.00

[1]Letter grade to GPA equivalency for graduate grades can be found at AP.3.2 (https://catalog.gmu.edu/policies/academic/grading/)

How will I be assessed? Quizzes: All quizzes will be assessed on Blackboard and will consist of multiple choice, fill in the blank, matching, or other (deceptively) simple modes of delivery. Homework: Homework assignments 1 & 2 will be assessed via pre-established criteria (see Homework on the previous page). Homework 3 will be assessed using the same rubric as your final paper. This will provide you with specific, guided feedback, that you can use to plan and revise. The rubric accounts for how drafts will be assessed as compared to final papers (see the footnote on rubric). Project proposal, Presentation, and paper: Please see a detailed rubric for each assignment.

Schedule

Each class will cover a concept in Sensory Ecology. We will follow a guided reading list (under the Reading Column) where you will find a mandatory reading assignment. In addition, you will find several alternative selected reading assignments (you must choose one of these additional articles to read). These will be covered in our lectures. Please be prepared to discuss your readings in depth with the class. This schedule is subject to change – any changes will be communicated in class and on Blackboard.

Date*	Lecture Topic	Reading	Alternative Reading‡	Assignments†
25-Aug	Introduction	[1]	[2–5]	
1-Sep	Sensory drive	[6]	[7–9]	Quiz 1
8-Sep	Principles of communication	[10]	[11,12]	Homework 1
15-Sep	Stimulus transmission	[13]	[14–21]	
22-Sep	Signal production	[22]	[23–26]	Homework 2
29-Sep	Chemical and temperature signals	[27]	[28–34]	Quiz 2
6-Oct	Mechanical signals	[35]	[36–43]	Project 1 due
13-Oct	Acoustic signals	[44]	[45–50]	
20-Oct	Light signals	[51]	[52–61]	
27-Oct	Measurement techniques	[62]	[63–65]	Quiz 3
3-Nov	***Columbus Day***			
10-Nov	Color spaces and signal discrimination	[66,67]	[68–73]	Homework 3
17-Nov	Multimodal signals and crypsis	[74]	[75–81]	
24-Nov	Perceptual mechanisms	[82]	[83–89]	
1-Dec	Unresolved questions	[90]	[91,92]	Final paper due
8-Dec	*Reading period*			
15-Dec				Project 2 due

*** Dates approximate and will be updated each term. Here based on Fall 2020**

† Due dates will be adjusted to accommodate religious observance upon request.

‡ The full reading list (Reading and Alternative Reading) in a separate document.

Reading list

1. Stevens M. 2010 Sensory ecology, evolution, and behavior. Curr. Zool. 56.

6. Ryan MJ. 1998 Sexual selection, receiver biases, and the evolution of sex differences. Science 281, 1999–2003.

10. Wilson DR, Hare JF. 2004 Ground squirrel uses ultrasonic alarms. Nature 430, 523.

13. Derryberry EP, Phillips JN, Derryberry GE, Blum MJ, Luther D. 2020 Singing in a silent spring: Birds respond to a half-century soundscape reversion during the COVID-19 shutdown. Science 370, 575–579

22. Lardner B, bin Lakim M. 2002 Tree-hole frogs exploit resonance effects. Nature 420, 475.

27. Hagelin JC, Jones IL, Rasmussen LEL. 2003 A tangerine-scented social odour in a monogamous seabird. Proc. R. Soc. B Biol. Sci. 270, 1323–1329.
35. Forterre Y, Skotheim JM, Dumais J, Mahadevan L. 2005 How the venus flytrap snaps. Nature 433, 421–425
44. Podos J. 2001 Correlated evolution of morphology and vocal signal structure in Darwin's Finches. Nature 409, 185–188.
51. Ghosh DD, Lee D, Ji X, Horvitz HR, Nitabac MN. 2021 C. elegans discriminates colors to guide foraging. Science 371, 1059–1063.
62. Van Der Kooi CJ, Elzenga JTM, Dijksterhuis J, Stavenga DG. 2017 Functional optics of glossy buttercup flowers. J. R. Soc. Interface 14, 20160933
66. Vorobyev M, Osorio D. 1998 Receptor noise as a determinant of colour thresholds. Proc. R. Soc. London B 265, 351–358
67. Stoddard MC, Prum RO. 2008 Evolution of avian plumage color in a tetrahedral color space: a phylogenetic analysis of new world buntings. Am. Nat. 171, 755–76.
74. Niu Y, Stevens M, Sun H. 2021 Commercial harvesting has driven the evolution of camouflage in an alpine plant. Curr. Biol. 31, 446-449
82. ten Cate C, Rowe C. 2007 Biases in signal evolution: learning makes a difference. Trends Ecol. Evol. 22, 380–387
90. Cuthill IC et al. 2017 The biology of color. Science 357, eaan0221