Conservation in Working Landscapes (WFC 198)

Conservation in Working Landscapes (WFC 198) is a 4-unit course with a twice-a-week, 1.5 hour lecture and once-a-week 1 hour section. Lectures focus on the theory and practice of conservation in working landscapes, and will be placed into four modules: (1) biodiversity conservation in working landscapes, (2) ecosystem services and disservices in working landscapes, (3) a survey of 'anthromes' (*i.e.,* different anthropogenic land use types), and (4) working landscapes in policy and practice. Lectures assume prior ecological coursework. BIS2b is a required prerequisite; either EVE 101 or ESP 100 is recommended (but not required). Sections are designed to guide students through an authentic research experience (see below), offering experiential learning opportunities in working landscapes.

Lecture Location & Time: T/TH 2:10-3:40, Olson 205; **Zoom Link:** https://ucdavis.zoom.us/j/93665096172; **Meeting ID**: 936 6509 6172; **Passcode**: wfc198

Section Locations & Times: Th 9:00-9:50 Physics 140
https://ucdavis.zoom.us/j/93288794526; **Meeting ID:** 932 8879 4526; **Passcode**: wfc198

Instructor: Daniel S. Karp
Email: dkarp@ucdavis.edu **Include WFC 198 in subject line**
Office Hours: Mondays 12:00-1:00; Wednesdays 2:30-3:30
Zoom Link: https://ucdavis.zoom.us/j/95011588655
Meeting ID: 950 1158 8655; Passcode: wfc198

TA: Katherine Lauck
Email: kslauck@ucdavis.edu **Include WFC 198 in subject line**
Office Hours: Tuesdays 1:00-2:00; Thursdays 11:00-12:00
Zoom Link: https://ucdavis.zoom.us/j/99938341109
Meeting ID: 999 3834 1109; Passcode: wfc198

Reading Materials:

1. **Academic articles**, Available through the course website (no textbook required)

Purpose

Conservation scientists have long recognized the importance of protected areas to mitigate the ongoing biodiversity crisis. Nonetheless, despite protected area coverage increasing over the last century, the ~15% of Earth's surface that is currently preserved for nature is dwarfed by the ~75% that has been altered by humanity. As urbanization and agricultural expansion continues, a critical challenge will be finding ways to conserve biodiversity and Earth's life-support systems while satisfying our basic needs. Meeting this challenge requires looking beyond protected areas to also pursue conservation in 'working landscapes' composed of crop fields, pastures, settlements, forestry systems, and patches of semi-natural habitat.

WFC 198 is intended to (1) introduce students to the ecology and natural history of working landscapes; (2) critically evaluate tradeoffs (and potential synergies) that arise when simultaneously pursuing conservation, food production, and human livelihood objectives; and (3) empower students to design, implement, and communicate their own research projects in real working landscapes. In doing so, WFC 198 will help students understand and develop useful skills for the modern conservation scientist. Specifically, students will learn basic science literacy (*e.g.,* by reading and critiquing scientific articles), how to develop and answer novel scientific questions, how to collaborate in groups, and how to clearly communicate their findings.

Learning Objectives

By the end of the course, students should be able to answer the following questions…

1. Which species and what dimensions of biodiversity can be conserved in working landscapes? What traits do they share and can species evolve them?
2. How can working landscapes be co-managed for people and nature? What practices would help minimize costs/maximize benefits from biodiversity to farmers, urbanites, and others?
3. What are the challenges and opportunities associated with conserving biodiversity in farms, rangelands, cities, and forestry systems, both on land and in aquatic environments?
4. How could working landscape conservation be better incentivized?

Students will also learn how to…

5. Read and critique the primary literature focused on working landscape conservation.
6. Conduct a real-world research project related to working landscape conservation.
7. Leverage the skills/interests of other students to effectively conduct research in small teams.

The Classroom Environment and Student Wellness

Conservation biology suffers from cultural and gender biases that impede scientific progress and make for a less vibrant and inclusive workplace. Both for the people that lack opportunities to engage with conservation and for the sake of the discipline, I am committed to helping remove barriers and make our communities more inclusive. Conservation in working landscapes is particularly interwoven with issues surrounding diversity and justice. As such, we will return to these issues throughout the class. In this class, I have also tried to give more voice to those who have been excluded from conservation in the past. ***This is a work in progress***. More broadly, I strongly believe that all classrooms must be inclusive and welcoming environments. Please do not hesitate to bring to my attention (or the TA's attention) any areas for improvement or any actions or statements that made you feel uncomfortable, unsafe, or excluded.

Relatedly, it is important to acknowledge the many physical and mental health issues that can impede student learning (*e.g.,* anxiety, alcohol/drug problems, depression, strained relationships, *etc.*). If you are suffering from any issues, or other stressful events, consider reaching out to the Counseling Center for support: https://shcs.ucdavis.edu/services/counseling-services or call 530-752-0871. An on campus counselor or after-hours clinician is available 24/7. Finally, if you are a student who requires accommodations, please submit your SDC Letter of Accommodation to me as soon as possible, ideally within the first two weeks of this course. Anyone who is interested in learning more about the Student Disability Center (SDC) should contact them directly at sdc@ucdavis.edu or 530-752-3184.

COVID-19

I am very excited to be back in the classroom; however, it is important to acknowledge the major anxieties that many of us feel with the return to in-person activities. To make everyone feel safer, please abide by the following:

1. I promise to work with you so that you can succeed in this class and still stay at home if you feel sick or have been exposed to COVID-19. **Your grade will not suffer** by making the responsible choice to stay at home. Lectures will be recorded. Exam accommodations will be made. Just contact Dr. Karp or your TA ASAP to let us know your situation.
2. Please complete the Daily Symptom Survey and participate in the COVID-19 Testing program. Vaccinated people must test every 14 days (unvaccinated every four days). You can test more often (I test once-a-week).
3. Wear a well-fitted face covering in the classroom **and** during all outside fieldtrips.
4. Monitor your daily potential exposure reports and assist in contact tracing if you are contacted (or if you acquire the disease).

Land Acknowledgement

We should take a moment to acknowledge the land on which we are gathered. For thousands of years, this land has been the home of Patwin people. Today, there are three federally recognized Patwin tribes: Cachil DeHe Band of Wintun Indians of the Colusa Indian Community, Kletsel Dehe Wintun Nation, and Yocha Dehe Wintun Nation. The Patwin people have remained committed to the stewardship of this land over many centuries. It has been cherished and protected, as elders have instructed the young through generations. We are honored and grateful to be here today on their traditional lands.

Assessment (Overview)

Before each lecture, Prof. Karp will assign 1 mandatory scientific article to be discussed in class. Another article will be assigned as optional reading. Grades will be assigned as follows:

Assessment	**Value**	**Due date**
Quizzes	10%	Ongoing
Section participation	5%	Ongoing
Question and hypotheses	5%	October 18 (by 11:59 pm)
Methods summary	7.5%	October 29 (by 11:59 pm)
Midterm exam	20%	November 2
Reflection 1	2.5%	November 5 (by 11:59 pm)
Research report	20%	November 29 (by 11:59 pm)
Reflection 2	5%	November 29 (by 11:59 pm)
Final exam	25%	December 7 (6-8pm)

Please note that the grade mode in the course is letter grading. It has been changed from the grade mode listed in the General Catalog. Students wishing to petition for a P/NP grading variance must send a copy of the syllabus to the Office of the Registrar and file a "Grading Variance Exception" petition. If you have questions or need help with this, you may contact WFCB advisor, Erica Cefalo at emcefalo@ucdavis.edu for more information.

Late Policy: Students will lose 10% each day that an assignment is late. Canvas will lock out submissions immediately at 11:59pm the day an assignment is due. If an assignment is late, email it as soon as it is finished to both Prof. Karp and the TA. Any assignment that is not submitted by 11:59pm the day an assignment is due will be considered late. If canvas malfunctions, assignments can be emailed to Prof. Karp and the TA and still receive full credit (provided that the email is time stamped before the due date).

Tentative Schedule (Readings, topics, and timings subject to change)

Module I: Biodiversity conservation in working landscapes

WEEK 1

9/23- Lecture 1: Introduction to conservation in working landscapes

- **Topics:** (1) course structure/expectations; (2) history of conservation in working landscapes; (3) agricultural expansion and land-use trajectories
- **Required Reading:** Kremen, C. & Merenlender, A.M. (2018). Landscapes that work for biodiversity and people. *Science*, 362, 1–9
- **Optional Reading:** Ellis, E. *et al.* (2021) People have shaped most of terrestrial nature for at least 12,000 years. *PNAS*, 118m e2023483118.

Section 1: Reading and writing scientific manuscripts

- **Activities:** (1) review the core sections of a scientific paper; (2) identify common writing

pitfalls and solutions; (3) learn about the course research project; (4) form research groups

WEEK 2

9/28- Lecture 2: Chemical intensification

- **Topics:** (1) the Green Revolution; (2) impacts and solutions to overfertilization; (3) impacts and solutions to excessive pesticide applications
- **Required Reading:** Foley, J.A., *et al.* (2011). Solutions for a cultivated planet. *Nature*, 478, 337–342
- **Optional Reading:** Tilman, D. *et al.* (2001). Forecasting agriculturally driven global environmental change. *Science*, 292, 281-284.

9/30- Lecture 3: Climate/Land-use interactions

- **Topics:** (1) how climate and land-use change exacerbate each other; (2) interactive effects of climate and land-use change on wildlife; (3) potential solutions
- **Required Reading:** Williams, J.J. & T. Newbold (2019). Local climatic changes affect biodiversity responses to land use: a review. *Diversity and Distributions,* 26, 76-92.
- **Optional Reading:** Brook, B. *et al.* (2008). Synergies among extinction drivers under global change. *Trends in Ecology and Evolution*, 23, 453-460.

Section 2: Field trip

- **Activities:** (1) visit the UC Davis student farm and learn about the challenges/opportunities of diversified farming, as well as conducting research on farms; (2) become acquainted with the farm for research projects.

WEEK 3

10/5- Lecture 4: Matrix Ecology and Theory

- **Topics**: (1) from island biogeography to countryside biogeography; (2) the matrix as habitat; (3) source-sink dynamics and ecological traps
- **Required Reading:** Frishkoff, L.O. *et al.* (2019). Countryside biogeography: the controls of species distributions in human-dominated landscapes. *Curr. Landsc. Ecol. Reports*, 4, 15–30
- **Optional Reading:** Kennedy, C. *et al.* (2010) Landscape matrix and species traits mediate responses of Neotropical resident birds to forest fragmentaiton in Jamaica. *Ecol. Mono.,* 80, 651-669.

10/7- Lecture 5: Winners and Losers

- **Topics:** (1) variation among species in responses to land-use change; (2) predicting winners/losers from functional traits; (3) evolution and adaptation in working landscapes
- **Required Reading:** Campbell-Staton, S.C., *et al.* (2020). Parallel selection on thermal physiology facilitates repeated adaptation of city lizards to urban heat islands. *Nat. Ecol. Evol.*, 4, 652–65
- **Optional Reading:** Miles, L.S. *et al.* (2020) Urban evolution comes into its own: emerging themes and future directions of a burgeoning field. *Evolutionary Applications*, 14, 3-11.

Section 3: Preparing for field experiments

- **Activities:** (1) learn about how sentinel experiments are used to answer applied/basic ecological questions; (2) construct plasticine caterpillars; (3) design sentinel experiments

WEEK 4

10/12- Lecture 6: Dimensions of Biodiversity

- **Topics**: (1) biodiversity across scales [alpha, beta, and gamma diversity]; (2) biodiversity across dimensions [taxonomic, functional, and phylogenetic diversity]; (3) at-risk species in working landscapes

- **Required Reading:** Ponisio, L.C. *et al.* (2015) On-farm habitat restoration counters biotic homogenization in intensively managed agriculture. *Glob. Chan. Bio.*, 22, 704-715.
- **Optional Reading:** Wood, S.A. *et al.* (2015) Functional traits in agriculture: agrobiodiversity and ecosystem services. *Trends Ecol. Evol.,* 30, 531-539.

Module II: Ecosystem Services and Disservices in Working Landscapes

10/14- Lecture 7: Physical health and Disease

- **Topics**: (1) physical health; (2) zoonotic diseases; (3) foodborne pathogens
- **Required Reading:** Jones, B.A., *et al.* (2013). Zoonosis emergence linked to agricultural intensification and environmental change. *Proc. Natl. Acad. Sci.*, 110, 8399–8404
- **Optional Reading:** Karp, D.S., *et al.* (2015). Comanaging fresh produce for nature conservation and food safety. *Proc. Natl. Acad. Sci.*, 112, 11126–11131

Section 4: Conducting field experiments

- **Activities:**
  - *Thursday section:* (1) visit the Student Farm; (2) deploy plasticine caterpillars; (3) deploy mealworm sentinels; (4) take GPS points; (5) measure distances to field edges
  - *Friday section:* (1) visit the Student Farm; (2) collect plasticine caterpillars; (3) collect mealworm sentinels; (4) take GPS points; (5) measure distances to field edges

WEEK 5

10/19- Lecture 8: Mental health and wellbeing

- **Topics**: (1) psychological benefits of nature experience; (2) cultural services; (3) disservices and harms
- **Required Reading:** Echeverri, A. *et al.* (2021). Avian cultural services peak in tropical wet forests. *Conserv. Lett.*, 14, e12763.
- **Optional Reading:** Bratman, G. *et al.* (2019). Nature and mental health: An ecosystem service perspective. *Sci. Adv.*, 5, eaax0903

10/21- Lecture 9: Pollination

- **Topics**: (1) global reliance on pollinators; (2) pollinator declines; (3) local and landscape-level agricultural practices to benefit pollinators
- **Required Reading:** Garibaldi, L. *et al.* (2014) From research to action: enhancing crop yield through wild pollinators. *Fron. Ecol. Env.,* 12, 439-447.
- **Optional Reading:** Potts, S. *et al.* (2010) Global pollinator declines: trends, impacts and drives. *TREE,* 25, 345-353.

Section 5: Data entry and graphing

- **Activities:** (1) enter data and read it into R; (2) learn basic data manipulation techniques; (2) construct simple plots

WEEK 6

10/26- Lecture 10: Pest control

- **Topics**: (1) integrated pest management; (2) conservation biological control; (3) local and landscape-level agricultural practices to benefit predators and parasitoids
- **Required Reading:** Poveda, K. *et al*. (2012). Landscape simplification and altitude affect biodiversity, herbivory and Andean potato yield. *J. Appl. Ecol.*, 49, 513-522
- **Optional Reading:** Landis, D.A *et al*. (2000). Habitat management to conserve natural enemies of arthropod pests in agriculture. *Annu. Rev. Entomol.*, 45, 175–201

10-28- Lecture 11: Human-wildlife conflict

- **Topics**: (1) crop raiding; (2) livestock depredation; (3) human injury/mortality risk; (4)

potential solutions— policies, local deterrents, and farmer compensation
- **Required Reading:** Treves, A. *et al.* (2016). Predator control should not be a shot in the dark. *Fron. Ecol. Env.*, 14, 380-388. (also read the supplementary information attached)
- **Optional Reading:** Struebig, M. *et al.* (2018). Addressing human-tiger conflict using socio-ecological information on tolerance and risk. *Nat. Comm.*, 9, 3455.

Section 6: Review session
- **Activities:** (1) midterm review session

Module III: A Survey of 'Anthromes'

WEEK 7

11-2 MIDTERM
- **Topics**: covers all readings and lectures through modules I and II.

11/4- Lecture 12: Urban areas
- **Topics**: (1) urban ecology; (2) urban areas as coupled human-natural systems
- **Required Reading:** Schell, C., *et al.* (2020) The ecological and evolutionary consequences of systemic racism in urban environments. *Science*, 369, eaay4497.
- **Optional Reading:** Faeth, S., *et al.* (2011) Urban biodiversity: patterns and mechanisms. *Ann. NY Acad. Sci.*, 1223, 69-81.

Section 7: Statistics and modeling
- **Activities:** (1) implement linear models and ANOVA in R; (2) verify that data meet model assumptions

WEEK 8

NOTE: No quiz will be administered this week.

11/9- Lecture 13: Farms
- **Topics**: (1) agroecological intensification on smallholder and intensive farms; (2) land-sharing versus land-sparing
- **Required Reading:** Schulte, L.A. *et al.* (2017). Prairie strips improve biodiversity and the delivery of multiple ecosystem services from corn–soybean croplands. *Proc. Natl. Acad. Sci.*, 114, 11247–11252
- **Optional Reading:** Tamburini, G. *et al.* (2020) Agricultural diversification promotes multiple ecosystem services without compromising yield. *Sci. Adv.,* 6, eaba1715.

11/11- Veteran's Day Holiday

No Section: Veteran's Day Holiday

WEEK 9

11-16 Lecture 14: Working forests and rangelands
- **Topics**: (1) overgrazing and conversion to rangelands; (2) silvopastoral systems; (3) impacts of timber production; (3) fire management
- **Required Reading:** Murgueitio, E*. et al.* (2011). Native trees and shrubs for the productive rehabilitation of tropical cattle ranching lands. *For. Ecol. Manage.,* 261, 1654–1663
- **Optional Reading:** Betts, M. *et al.* (2021). Producing wood at least cost to biodiversity: integrating Triad and sharing–sparing approaches to inform forest landscape management. *Biol. Rev.,* 96, 1301-1317.

11/18- Lecture 15: Aquatic systems
- **Topics**: Guest lecture from Dr. Rob Lusardi, Adjunct Professor, Department of Wildlife, Fish,

and Conservation Biology, UC Davis
- **Required Reading:** Kiernan, J.D., *et al.* (2012) Restoring native fish assemblages to a regulated California stream using the natural flow regime concept. *Ecol. Apps.*, 22, 1475-1482.
- **Optional Reading:** Katz, J. *et al*. (2017) Floodplain farm fields provide novel rearing habitat for Chinook salmon. *PLoS One*, 12, e177409.

Section 8: Land Sharing v. Land Sparing Debate
- **Activities:** (1) Debate land sharing v. land sparing
- **Required Reading:** Kremen, C. (2015) Reframing the land-sparing/land-sharing debate for biodiversity conservation. *Annals of the New York Academic of the Sciences*, 1355, 52-76.

Module IV: Working Landscapes in Policy and Practice

WEEK 10

NOTE: No quiz will be administered this week.

11/23- Lecture 16: Working landscape conservation in California
- **Topics**: Guest lecture from Dr. Rodd Kelsey, Associate Director of The Natural Conservancy's California Water Program
- **Required Reading:**
  1. Kelsey, T.R. *et al.* (2021) Strategic selection of lands for rewilding to optimize outcomes and minimize costs. Butterfield, H.S., Kelsey, T.R., and Hart, A. (eds). 2021. Rewilding Agricultural. In: Landscapes: A California Study in Rebalancing the Needs of People and Nature. Island Press, Washington, D.C.
  2. Hart, A.K. (2021) Learning from case studies to encourage landowner participation in rewilding the San Joaquin Valley. Butterfield, H.S., Kelsey, T.R., and Hart, A. (eds). 2021. Rewilding Agricultural. In: Landscapes: A California Study in Rebalancing the Needs of People and Nature. Island Press, Washington, D.C.
- **Optional Reading:** (both readings are required this time)

11/25, Thanksgiving Holiday

Thanksgiving break: no section

WEEK 11

11/30- Lecture 17: Working landscape policy
- **Topics**: (1) regulations; (2) incentive programs and market-interventions; (3) community-based natural resources management; (4) education and training programs.
- **Required Reading:** Batáry, P. *et al.* (2015). The role of agri-environment schemes in conservation and environmental management. *Conserv. Biol.,* 29, 1006–1016
- **Optional Reading:** Iles, A. & R. Marsh (2012) Nurturing diversified farming systems in industrialized countries: how public policy can contribute. *Ecol. Soc.,* 17, 42.

12/2- Lecture 18: Decision making
- **Topics**: (1) the theory of planned behavior; (2) additional factors
- **Required Reading:** Carlisle, E. *et al.* (In Review) Adoption of diversification practices among organic vegetable growers on the California Central Coast.
- **Optional Reading:** Chapman, M., *et al.* (2019) When value conflicts are barriers: can relational values help explain farmer participation in conservation incentive programs? *Land Use Policy*., 82, 464-475.

Section 9: Final Review Session

- **Activities:** (1) Final review session.

Course-based Research Project:
How can we bolster natural pest regulation in working landscapes?

Note: The text below is an overview of the assignment. Be sure to consult the separate, more substantive assignment descriptions before completing any assignment.

Vertebrate and invertebrate crop pests represent a major constraint on food production, causing up to 20% of global crop yields to be lost each year. For centuries, farmers have relied on the natural enemies of crop pests— their predators and parasitoids— to help mitigate this damage. However, as agriculture expanded and intensified over the last half century, pests exploded to exploit vast monoculture fields. Farmers turned to pesticides to control pests, with cascading implications for environmental and human health. However, pests regularly resurged as they evolved pesticide resistance and pesticides eliminated their natural enemies. In recent decades, agroecologists have advocated integrated pest management principals, whereby actions are taken to bolster the natural enemies of crop pests and pesticides are used as a last resort. However, the efficacy of conservation practices in reducing pests is often called into question, as they sometimes deliver effective control but, in other cases, can actually bolster crop pests.

In WFC 198, students will design field experiments to broadly explore how working landscapes could be better managed to facilitate natural pest regulation.

- In section 1, student will form research groups of ~4 students.
- In section 2, students will travel to the UC Davis Student Farm to learn about conducting research on private lands.
- In section 3, students will learn how to implement 'sentinel pest experiments,' using plasticine clay caterpillars and mealworms to assay predation rates in the field.
- In section 4, students will travel to the Student Farm, where they will practice conducting sentinel experiments.
- In section 5, students will learn how to enter, manipulate, and graph data in R.
- In section 7, students will learn basic data analysis techniques.

Many possibilities exist regarding the questions that students could explore. For example, students could compare predation rates: (1) between different land-use types; (2) between sites in the interior versus the edge of a farm; (3) through using plasticine clay caterpillars versus live mealworms; and so much more!

Each group will be responsible for writing a report to communicate their results. Working as a team is essential in science but can be difficult if some team members monopolize the work and/or others do not contribute adequately. Students will be asked to write a 2-paragraph reflection midway through the project to identify sources of conflict within the group and discuss how they have/plan to contribute looking forward. These reflections will be graded and can influence others' grades. They will also be used so that Prof. Karp or the TA can facilitate constructive conversations about group dynamics and conflict resolution (if needed). Along with the report, students will also turn in a final 2 paragraph reflection that both outlines their contributions to the project and discusses group dynamics. The reflection will be graded.

Assessment Overview

Note: The text below is an overview of the assignments. Be sure to consult the separate, more substantive assignment descriptions before completing any assignment.

Quizzes: To ensure students are keeping up with online lectures and sections, online quizzes will be administered online and due by Friday at 11:59 pm each week. Quizzes will draw from

the week's lectures and will be untimed. Students are allowed to miss **ONE** assignment without affecting their grade. ***NOTE: No quizzes will be administered during the two holiday weeks (i.e., weeks 8 and 10).***

Section participation: The TA will give full credit to students that actively participate in the course sections. Students are allowed to miss **ONE** section without it affecting their grades. ***NOTE: students who feel sick or were exposed to COVID-19 should stay home. Email Dr. Karp and TA Lauck to let us know your situation. Under no circumstances will your grade be affected by the (responsible) decision to stay at home.***

Midterm exam: An in-class exam will be administered midway through the course (at the beginning of week 6). The midterm will cover all lectures and assigned readings in the first two modules of the course (biodiversity conservation in working landscapes; ecosystem services and disservices in working landscapes).

Question and hypotheses: Students will develop possible research questions and hypothesis. In their research groups, students will then be asked to finalize one core question that will guide their project, as well as one corresponding hypothesis for what they will find. Each group will provide one paragraph of rationale for why they expect their hypothesis to be true. This rationale must cite at least 2 papers. They will also be asked to state the null hypothesis and one alternative hypothesis, along with 2-3 sentences of rationale for why the alternative hypothesis could be true (citing at least 1 paper). One document will be handed in for each group at the beginning of week 6.

Methods summary: Each group will be asked to develop a one-page summary of the methods they plan to use to conduct their study (single spaced, 12pt font, 1-inch margins). At the top of the document, groups will list their guiding question and the corresponding hypothesis. The assignment will be due in the beginning of week 7.

Reflection 1: Each individual will be asked to write a two-paragraph reflection about how their research group has functioned to date. The first paragraph will constitute a self-reflection, discussing what the student has contributed to the team and how he/she plans to participate looking forward. The second paragraph will be a candid discussion of team dynamics. This will be confidential and represents a space for students to discuss whether or not any project members have been failing to pull their weight or are monopolizing the research process.

Note: Dr. Karp reserves the right to change a student's grade on the reflection if reflections from other group-members indicate that the student has not meaningfully contributed to the group. Dr. Karp will speak with the student in question before doing so. The assignment will be due in the beginning of week 7.

Research report: Each group will be asked to turn in a research report (5 pages, single spaced, 12pt font, 1 inch margins). Reports will include the following sections:

- Abstract: A one paragraph overview of the study, methods, core findings, and implications.
- Introduction: This section will set the work in context and provide relevant background. Students will include at least 10 citations of journal articles. The section will end with a few sentences outlining the research question and predictions that guided each group's work
- Methods: Students will document their approach for collecting and analyzing their data. The methods should be written with sufficient detail such that another scientist could replicate their work.
- Results: This section will contain declarative statements about the core findings, with relevant statistics to back up their claims. At least one graph will be included in this section, alongside a descriptive caption.
- Discussion: The report will end with a short discussion of the implications of the students'

work. The students will set their work in the context of the broader literature, citing at least 10 peer-reviewed publications. It is ok if up to 5 of these citations are the same papers as in the introduction.
- Works cited: A short references section will be submitted using a standardized format (see separate assignment description).

The assignment will be due in the beginning of week 11.

Reflection 1: Each individual will also submit another two-paragraph reflection. As before, the first paragraph will constitute a self-reflection, discussing what the student has contributed to the team and to the project. The second paragraph will again focus on group dynamics and provide space for students to discuss whether any team member did not sufficiently contribute to the team. Again, Dr. Karp reserves the right to change a student's grade if reflections from other group-members indicate that the student has not meaningfully contributed to the group. Dr. Karp will speak with the student in question before deciding to change his or her grade. The assignment will be due in the beginning of week 11.

Final exam: The final exam will cover all course lectures and readings but emphasize the second half of the course (the part not covered in the first midterm).