

## Conservation in Working Landscapes (WFC 126)

Conservation in Working Landscapes (WFC 126) 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, distributed across 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:

Tuesdays/Thursdays 2:10-3:40 pm, Young Hall 184

### Section Locations & Times:

A01— Thursdays, 9:00-9:50 am, Social Science and Humanities 70

A02— Thursdays, 10:00-10:50 am, Edwards Family Athletic Center 1011

A03— Thursdays, 11:00-11:50 am, Edwards Family Athletic Center 1011

---

### Instructor: Daniel S. Karp

Email: [dkarp@ucdavis.edu](mailto:dkarp@ucdavis.edu)

Office Hours: Tuesdays, 10:00-11:00

Location: 1071 Academic Surge

Include **WFC 126** in subject line

### TA: Katherine Lauck

Email: [kslauck@ucdavis.edu](mailto:kslauck@ucdavis.edu)

Office Hours: Thursdays, 12:15-1:15

Location: 1352 Academic Surge

Include **WFC 126** in subject line

### Reading Materials:

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

### Purpose

Conservation scientists have long recognized the importance of protected areas in mitigating 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 126 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 126 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 [sdcc@ucdavis.edu](mailto:sdcc@ucdavis.edu) or 530-752-3184.

---

### COVID-19

I will work with you so that you can succeed in this class and stay at home if you feel sick or have been exposed to COVID-19. **Your grade will not suffer** if you stay at home after getting sick or being exposed to COVID. contact Dr. Karp or your TA to let us know your situation. Relatedly, please consider wearing a mask in the classroom.

---

### 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

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 (Individual)	5%	Thursdays (by 11:59 pm)
Section participation (Individual)	5%	Ongoing
Question and hypotheses (Group)	5%	October 16 (by 11:59 pm)
Methods summary (Group)	5%	October 23 (by 11:59 pm)
Midterm exam (Individual)	20%	October 31 (in class)
Reflection 1 (Individual)	2.5%	November 6 (by 11:59 pm)
Graphs and captions (Group)	10%	November 27 (by 11:59 pm)
Poster presentation (Group)	15%	December 7 (in class)
Reflection 2 (Individual)	7.5%	December 8 (by 11:59 pm)
Final exam (Individual)	25%	December 13 (1-3 pm)

### Late Policy

Students will lose 10% each day that an assignment is late. Any assignment that is not submitted by 11:59pm the day an assignment is due will be considered late. If canvas malfunctions and you cannot turn in an assignment, then simply email your assignment to Prof. Karp and the TA. You will still receive full credit if the email is time stamped before the due date.

The late policy does not apply to the exams and presentations that occur in-class, on the date/time noted above.

The late policy also does not apply to quizzes. Quizzes must be turned in by the due date or will receive no credit. However, to accommodate unforeseen circumstances, illnesses, *etc.*, students are allowed to miss **two** quizzes. Those quizzes will be replaced with 100% scores at the end of the quarter.

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

#### ***Module I: Biodiversity conservation in working landscapes***

##### WEEK 1

#### ***9/28- 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

#### ***10/3- 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.

### **10/5- 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**

### **10/10- 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 fragmentation in Jamaica. *Ecol. Mono.*, 80, 651-669.

### **10/12- 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**

### **10/17- 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**

### **10/19- 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:** (1) visit the Student Farm; (2) deploy plasticine caterpillars; (3) deploy mealworm sentinels; (4) take GPS points; (5) measure distances to field edges

#### **10/22, Sunday @ 9am- Weekend field trip**

- (1) visit the Student Farm; (2) collect and score plasticine caterpillars; (3) collect and score mealworm sentinels

### **WEEK 5**

#### **10/24- 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

#### **10/26- Lecture 9: 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 5: Review session**

- **Activities:** (1) midterm review session

### **WEEK 6**

#### **10/31- Midterm**

- **Topics:** Encompasses all readings and lectures through Week 5 (i.e., the human-wildlife conflict lecture).

#### **11/2- 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

#### **Section 6: Data entry and graphing**

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

### **WEEK 7**

#### **11/7- Lecture 11: 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.

### **Module III: A Survey of ‘Anthromes’**

#### **11/9- Lecture 12: 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.

#### **Section 7: Statistics and modeling**

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

### **WEEK 8**

#### **11/14- 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.

#### **11/16- Lecture 14: 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.

### **WEEK 9**

#### **11/21- Lecture 15: 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.

**11/23- No class due to Thanksgiving holiday. Quiz 9 is still due, however!**

**No section due to Thanksgiving holiday**

### **Module IV: Working Landscapes in Policy and Practice**

#### **WEEK 10**

#### **11/28- Lecture 16: 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.

#### **11/30- Lecture 17: Transformative change (Guest lecture: Prof. Claudio Gratton, University of Wisconsin at Madison)**

- **Topics:** (1) decision support in Midwestern agriculture, (2) what is needed for agriculture to become more sustainable and resilient
- **Required Readings:**
  1. Prokopy, L.S., et al.. 2020. The urgency of transforming the Midwestern U.S. landscape into more than corn and soybean. *Agric Human Values* 1–3.
  2. Pronczuk, M., Moses, C., 2023. Labeled Climate Culprits, European Farmers Rebel Over New Standards. *The New York Times*. Published Aug. 26, 2023 Updated Aug. 28, 2023

#### **Section 9: Poster presentations**

- Learning Objectives: (1) Design an attractive and informative poster; (2) Articulate how to avoid common pitfalls in poster design

#### **WEEK 11**

#### **12/5- Lecture 18: Decision making**

- **Topics:** (1) the theory of planned behavior; (2) additional factors controlling decision-making
- **Required Reading:** Carlisle, E. *et al.* (2022) Organic farmers face persistent barriers to adopting diversification practices in California's Central Coast. *Agro. Sus. Food Sys.*, 46, 1145-1172.
- **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.

#### **12/7- Lecture 19: Research symposium**

- **Topics:** In-class poster symposium

#### **Section 10: Final Review Session**

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

#### **WEEK 12**

#### **12/13- Final Exam (1-3 pm)**

- **Topics:** Covers all readings and lectures throughout the course.

---

**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. Yet 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 126, 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 4-5 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.
- On Sunday, 10/22, students will take a weekend fieldtrip to the Student Farm, where they will collect the clay caterpillar models and mealworms.
- In section 6, students will learn how to enter, manipulate, and graph data in R.
- In section 7, students will learn basic data analysis techniques.
- In section 9, students will learn how to present their results in a scientific poster.

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 creating a scientific poster showcasing their findings and presenting their work within an in-class research symposium. 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 Thursday at 11:59 pm each week. Quizzes will draw from the week's lectures and will be untimed. No late quizzes will be accepted; however, students will be able to replace **TWO** quizzes with 100% scores (meaning two quizzes can be missed without penalty).

**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 the TA to let us know your situation. Under no circumstances will your grade be affected by the (responsible) decision to stay at home.*

**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.

**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.

**Midterm exam:** An in-class exam will be administered. The midterm will cover all lectures and assigned readings through the end of week 5 (i.e., human-wildlife conflict lecture).

**Reflection 1:** Each student 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 represent a space for students to discuss whether any project member(s) have been failing to pull their weight or are monopolizing the research process.

After reading reflections, Dr. Karp and/or the TA will reach out to groups that are having trouble communicating and/or dividing up responsibilities. They will offer to organize a meeting to mediate team dynamics and propose constructive solutions moving forward.

**Graphs and captions:** Each group will prepare and submit a document containing **two** figures reflecting the most important findings from their research project. Each graph must depict the raw data. Graphs must also either show trend lines (for regression analyses) or means/confidence intervals (for ANOVA analyses or t-tests). Graphs must be attractively formatted with axes clearly labeled. Finally, descriptive captions must accompany each graph.

**Poster presentation:** Each group will prepare a 36inX 48in poster with the following sections: abstract, introduction, methods, results, and discussion. The amount of text will be minimized in favor of attractive visuals. Groups will present their posters at a research symposium in class.

**Reflection 2:** Each student will 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.

Hopefully, any issues in work division and/or group dynamics would have been resolved after meeting with Dr. Karp or the TA following the first reflection. If not, 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.

**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).