Course Setup

UC DAVIS HORTICULTURE AND D-LAB TOOLKIT

How to setup a client-focused, project-based course

USAID FROM THE AMERICAN PEOPLE

HORTICULTURE INNOVATION LAB

UC DAVIS UNIVERSITY OF CALIFORNIA

UC DAVIS D-Lab

UC DAVIS INNOVATION INSTITUTE FOR FOOD AND HEALTH

ACKNOWLEDGEMENTS

This manual is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the Horticulture Innovation Lab and do not necessarily reflect the views of USAID or the United States Government.

Funding for Davis D-Lab curriculum development was also provided by the UC Davis Institute for Food and Health and UC Davis Global Affairs, which helped inform the contents of this toolkit.

The original D-Lab was founded at MIT by Amy Smith in 2002 based on a single course called the "Haiti Class." Dr. Kurt Kornbluth was involved in setting up MIT's D-Lab and founded Davis D-Lab in 2009.

EXECUTIVE SUMMARY

This manual explains the process of setting up a client-focused, project-based course with specific examples from our classes. It includes advice on what makes a good project, how to find and choose clients, student recruitment, and identifying resources like funding and curriculum materials. The information here can be used to set up a Feasibility Studies course, where students assess a proposed idea and make specific suggestions, or Design, Build, Test, where students create a physical prototype.

TABLE OF CONTENTS

WHAT IS CLIENT-FOCUSED, PROJECT-BASED LEARNING?

The purpose of project-based, client-focused courses is twofold: the first is to find sustainable, scalable solutions to pressing global issues; the second is to give students the skills they need to turn ideas into action.

In project-based courses, students work on one specific project for the duration of the course, applying what they learn to solve a real-world problem. Using a client-focused approach means the students are working on a problem for someone else; the client identifies the need and the project, then the students work with their client to define and complete a final deliverable by the end of the class.

The outcome is a course where students are fully engaged and motivated to do good work, and the client receives a free consulting service. The students, in turn, acquire professional skills and experience beyond academia, and our design-based approach allows them the freedom to explore and develop creative confidence. A successful project has the potential to make a positive impact in the local or global community, and it gives the institution an opportunity to form valuable new partnerships.

Teaching a successful project-based course requires a lot of preparation in advance, but we promise it will pay off. This guide is designed to walk you through the process of setting up your own project-based course from identifying resources at your institution, to project scoping, to recruiting clients.

FEASIBILITY STUDIES VS. DESIGN, BUILD, TEST

Our D-Lab courses are offered as a two-part module: Feasibility Studies and Design, Build, Test (DBT). In Feasibility Studies, students evaluate whether a project is a good idea; and if it is, how best to move forward. In Design, Build, Test, they design a physical prototype. Typically, projects will carry over from Feasibility Studies to DBT; in this case, the deliverable from Feasibility Studies may be specific design criteria and recommendations for prototyping. Feasibility studies emphasizes problem framing and background research and requires access to a classroom and research resources (such laptop computers); DBT emphasizes hands-on skills and requires access to workshop space, tools, and building materials.

We also teach a project-based class called “A Path to Zero Net Energy,” and are starting a new class called a Path to Zero Net Waste. These courses both follow the feasibility studies model.

KEY TERMS

CLIENT

The person or organization who provides the project and is the main contact for students as they work through the process.

PROJECT

The students will work on the same project for the duration of the quarter. Projects should address a need that has been identified *by the client*, and the end result should be something that will be useful to the client moving forward. Specific projects will vary depending on the theme of the course and the final deliverable— the end result could be a business plan, a working prototype, or an evaluation of different available technologies to solve an identified problem.

TEAM

A group of three students with different backgrounds who work on one project together for the entire course. We strongly recommend limiting group sizes to three; with four or more, groups have a difficult time coordinating when to meet up, and issues with social dynamics or uneven effort are more likely to come up.

MENTORS

Mentors are professionals with relevant expertise that can guide the students during their project. Students meet with their mentor early in the quarter, then check in periodically to report their progress, ask questions, and get feedback. This helps keep students on track, and mentors can suggest resources or offer suggestions to help students get "unstuck" when they encounter roadblocks. In certain cases, the clients may be able to serve as mentors. **Mentors should have expertise in different disciplines and be able to add to the course with their knowledge.**

REVIEWERS

We invite two to three individuals with relevant expertise to attend and provide feedback on the student's midterm and final presentations. These "reviewers" are ideally from different disciplines and can provide insight and guidance to help students approach their projects in a new way.

WHAT MAKES A GOOD PROJECT?

Since the projects are the most important part of the curriculum, selecting good projects is vital. Some key characteristics that make up a good project include:

The client. Above all, the client in a project must be communicative. That means they are willing and able to work with students, responding to questions relatively quickly so that students can move forward with their project.

Project scope. The scope of the project will be modified by the students during the course, but when the class starts it should already be well defined with an end-goal that is achievable given the limited time available to student teams.

Theme: Does your course have a theme, for example a focus on energy, agriculture, development, or entrepreneurship? If so, make sure the projects tie into the theme.

Interesting subject matter. The topic and type of work should be something students will be excited and motivated by so they stay engaged throughout the process.

Alignment with skillset. The project should be appropriate for the skillset of your students, while still giving them room to learn new things. It is also important to consider the expertise of available mentors, choosing projects where mentors will be able to advise students. For example, if a project involves computer programing, it will be essential to have some students who have experience working with computer software.

Required resources. What resources will the project require, and are they available? If the final deliverable is a prototype, you will need access to a workshop, tools, and a budget for materials. On the other hand, if the deliverable is a feasibility study or business plan it may require internet access or transportation.

Scalability. We look for projects that may be small but have the potential to be replicated at a larger scale.

Case Study:
New Roots Farm
Sacramento, CA

The New Roots Farm is run by the International Rescue Committee. They provide agricultural training, community farming, and business development tools for refugees. In 2017, they reached out to D-Lab as part of a food safety initiative.

A team of students designed and built a crop wash station as part of the Design, Build, Test course in 2017. In 2019, a new team evaluated treatment and reuse options for the crop-wash water for a Feasibility Studies class.

In both cases, the client was the New Roots Farm, though the two projects appeared very different. The end-deliverable for the first was a physical product; for the second, the students provided process diagrams with relevant policy and design considerations and used a decision matrix to make a final recommendation.

To read the final reports and see more examples of past D-Lab projects, please visit https://piet.ucdavis.edu/courses/.

FINDING GOOD CLIENTS

"Okay, makes sense. But there's one problem: I don't have any clients!"

We hear this response often, and it can be especially challenging when you are just starting a D-Lab and haven't yet developed a reputation and network. However, potential clients are everywhere! Projects can be sourced from faculty within your institution, local businesses or non-profits, and even personal connections. In our Path to Zero Net Energy class, many of our projects come from buildings on campus, and the clients are building & facilities managers. **The most important thing is that the students have a client who needs results and can answer specific questions about the project.**

THE PROCESS

1) Start by doing **outreach;** spread the word about your exciting new course among your coworkers. Identify potential clients within your community and reach out to them directly; one starting place could be organizations that partner with the Horticulture Innovation Lab. Emphasize the fact that *they will benefit* by participating as a client—the students will be dedicating an entire course to research an issue that the client themselves may not have time to address. Clearly communicate what will be required of the client and what they can expect to gain from the course.
    - Throughout this process, pay attention to how responsive the client is to your emails—if you struggle to get a prompt response, you can be sure your students will too. Send them multiple emails requesting information and keep track of how quickly they respond.

2) Clients who are interested in bringing a project to D-Lab must fill out an application. For an example, see our website: https://piet.ucdavis.edu/bring-project/. This is a necessary step to ensure that clients will be engaged. Please note that this form is modified to add questions that are specific to the course. For example, if your course has design component, you may ask the client what the physical output is that they want from the students. It may also be important to ask how much progress they have already made on the project.

STUDENT RECRUITMENT

A successful D-Lab class depends on finding highly motivated students from varied backgrounds, interests, and disciplines. In the months before D-Lab starts, we advertise it through flyers, email, and in-person announcements during other classes. Another strategy we have used is holding info sessions with lunch provided. We target different departments, including engineering, design, business, energy, agriculture, community development… the list goes on. In these announcements, we stress the fact that we welcome all perspectives; students do not need to be engineers or have technical experience to take D-Lab! We also encourage both undergraduates and graduate students to enroll in the course.

Next is one of the secrets to D-Lab success: students must *apply* to be part of the course. Students must submit a resume/CV and answer the following questions in their application:

Email

Name

Student ID

Graduate or Undergraduate

College

Major

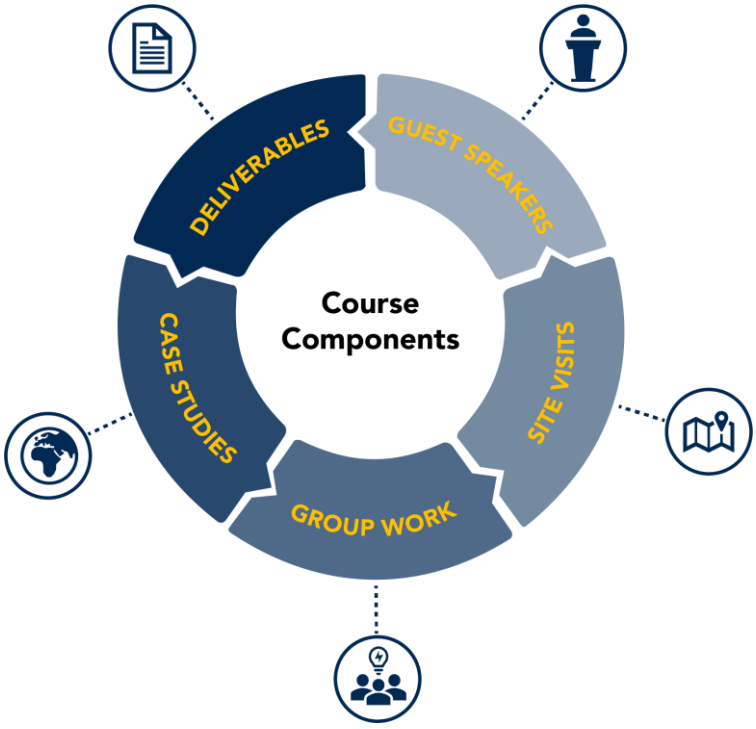
½ page essay answering "Why do you want to be in this course?"

We select students based on their skillset, drive to learn, and discipline (to ensure diversity in the course). However, even if everyone is accepted, **the process of applying alone means the course will attract more motivated, competent students** who will take the course seriously because they feel they have had to earn their place.

Ideally, you are aiming for a class size between 15-20 students with a range of skills and backgrounds.

BUILDING THE CURRICULUM

Before you can start building your course, you must decide on the theme or topic, and work out the administrative logistics with the department where it will be offered. The specifics of this will vary depending on how your institution.



The starting place to build curriculum are the deliverables, which are different for feasibility studies vs. DBT. They must be assigned in order, but you as the instructor should choose due dates that make sense given your timeline. Once you decide on the due dates, work backwards to determine when you need to present each deliverable.

You will likely need to work around the availability of guest speakers and site visits, so be sure to schedule these as soon as possible. Nearby farms, food processing facilities, water and/or waste treatment plants, and power plants all make great site visits if you have acecss to them. If you are struggling to find accessible places, look within your own institution. Site visits can be a great way to introduce students to on-campus resources.

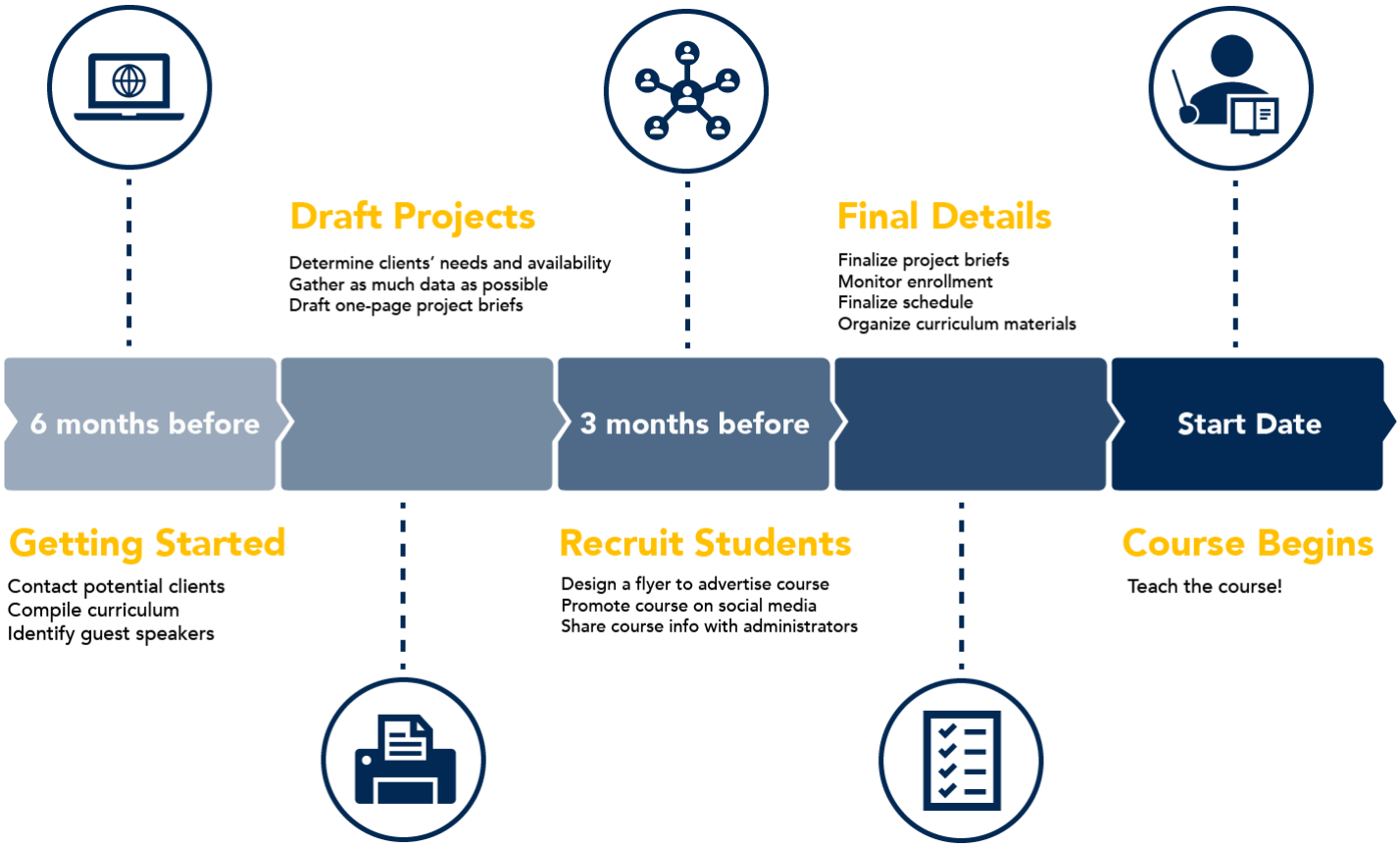
Next, find appropriate case studies you can present to the students. The best are drawn from your own experience—have you ever worked on a project related to sustainability or community development? How did you approach it? Was it successful? Why or why not? How did you measure success? Case studies are a great way to illustrate the four lenses of sustainability— invite your students to analyze your case study using each of the four lenses.

We have downloadable powerpoint slides on SWOT analysis, stakeholder analysis, life-cycle assessment, and policy ID that you can incorporate into your curriculum (look on the "Teaching Feasibility Studies" page). Beyond that, if there is sector-specific content you want to teach (for example, about different agricultural techniques, soil science, or principles of energy technology), identify what resources you'll need and schedule that accordingly.

Finally, schedule in group work time. Particularly towards the end of the quarter, we dedicate nearly half our class session time to group work.

TIMELINE

Once you have a clear idea of what you want to teach, start reaching out to potential clients, guest speakers, and co-instructors. You should begin this process roughly six months before the start date of your class, following the guidelines described in this manual. The goal is that by one month out, you have enough information about the projects and class size to start finalizing the schedule.



APPENDIX: SAMPLE PROJECT BRIEFS

POTATO STORAGE FACILITY (FEASIBILITY STUDY)

Location: Bareti, Republic of Georgia

In-Country Partner Organization: Environment & Development

Project Background: Bareti is located in the Tsalka Municipality of the Kvetmo-Kartli Region. A 2017 market analysis report indicates that the average potato production in the Kvemo-Kartli Region is 10.83 tons per hectare whereas the average for developed countries is 50-60 tons per hectare. Because these are mostly subsistence farmers, progression is stifled by any risk of a negative impact to their operation. This lack of economic mobility means that few farmers are willing and able to shift their methods unless it has been proven to be successful in the region. This has led to the continuation of outdated farming methods resulting in reduced yields thus continuing a cycle of poverty within this already depressed area.

Project Problem Statement: The lack of an adequate storage facility and potential for post-harvest loss has a large financial impact. Local farmers in Bareti and the surrounding villages continue to use dilapidated and ineffective storage facilities, which results in post-harvest loss. The farmers have seen firsthand the perpetuating loss in yield due to seed degradation. Because of freezing temperatures during storage months, the storage facility must be constructed in a way which maximizes insulation and minimizes heat loss. The client estimates that the space should be 500 square meters and accommodate for 60-70 farmers in the community who will pay for storage. There is interest in utilizing the space as a training facility outfitted with windows. The project budget is currently pending a $90,000 grant from the Japanese Embassy in Georgia.

Project Goals and Objectives:

1. Feasibility Study
    a. Investigate existing potato storage facility designs
2. Conceptual Design
    a. Conduct prior art research on windows, insulation, layout, energy efficiency, and any other pertinent components
    b. Work with the client to determine design criteria
3. Make recommendations for D-Lab II Design; Build; Test (D-Lab II)

SMALLHOLDER FARM COFFEE ROASTER (DESIGN, BUILD, TEST)

Location: Embu region, Kenya

In-Country Partner Organization/Primary Contact: Tonny Gitonga (coffee professional) / Kyle Freedman (Food Security & Agriculture Development Specialist)

Project Information: Smallholder coffee farmers lack the capital, access, and education to technologies that allow them to roast their coffee and learn about the process that adds the most value. This establishes the foundation for higher paying jobs to be created in coffee roasting as well as cupping, jobs which provide greater understanding of taste and quality. Not only would an affordable sample roaster allow farmers to taste their products to better inform their production, it would also provide opportunities for education and job growth down the value chain. The vision of this project is to develop an affordable ($40-$70) and scalable roaster for smallholder coffee farms throughout the world. The roaster will run on electricity from a stable grid source and should accommodate for around 500g to 1kg or about 1-2 lbs of coffee beans. Other key design criteria include visibility of the coffee beans while they roast as well as being able to hear the various stages of first and second crack.

Current Status: D-Lab I students conducted a feasibility study and began to test existing roasters, D-Lab II students will be expected to modify or prototype a more affordable roaster.

Project Goals and Objectives:

1. Work with the client to further frame the project including scope and define the design space
2. Investigate relevant prior art related to electric coffee roaster
3. Work with the client to determine and refine design constraints and criteria of the roaster
4. Either design, build, and test prototypes, or modify current designs

Final Deliverable: Easily modified or prototyped roaster

RENEWABLE ENERGY DESIGN AT THE MCLAUGHLIN RESERVE (PATH TO ZERO NET ENERGY)

The Donald and Sylvia McLaughlin Natural Reserve protects 7,000 acres of unusual habitats near Lower Lake, California. The reserve is managed by UC Davis and is co-owned by the University and the Barrick Gold Corporation (Homestake). Many years ago, the land was entrusted to UC Davis and is now mostly used by researchers conducting experiments on the rare flora and fauna found on the land around the facility. The developed area is composed of two main buildings: The Field Station and the Warehouse. The Field Station houses researchers, staff, and visitors while they are working at The Reserve. This building is mostly occupied during the Spring and Summer months and is only sporadically occupied during Fall and Winter. The Warehouse is occupied by both UC Davis and the mining company year-round, though their hour-by-hour occupancy is sporadic. The building can be separated into two use types: An office space and a large shop area used for storage and facility operations.

The Director of The Reserve recently began paying the energy bill and was appalled by the $2,000+/month cost for such little electricity usage. Because of their high monthly energy cost and the large amount of natural assets available, The Director is very interested in exploring renewable solar generation on site. This project will identify which technologies will work best for this facility, size the system, and provide a layout for the equipment. Financing options will be compared and recommendations for the best choice delivered to the client. In addition, this project will outline the approval process that must occur in order to make the project a reality.

Tasks for this project will include:

- Work with the client to further scope and frame the project, identifying priorities and key considerations.
- Perform a review of prior art and current best practices.
- Estimate annual generation needed to fully offset the electricity usage of the facility.
- Identify the technologies to be used and provide at least 3 conceptual designs for a renewable energy system, including size, layout, etc.
- Perform life cycle financial analysis to rank the above design options.
- Identify financing options and outline the UC approval process for project development.

This project is likely to involve 1 - 2 site visits to the McLaughlin Reserve, located near Lower Lake, CA.