

## Research Activities

**Discipline: Engineering**

**Level of Immersion: Full**

**Course: ECE 322L-Electronics II**

**Example 1: Research-based Laboratory Experience (RLab)-From Hypotheses to Characterization of Circuits.**

The RLab is based on a laboratory component of the course, where students have the opportunity to learn research practices while implementing them.

Lab assignments are made available in advance on UNM Canvas. Students are required to maintain a laboratory notebook with procedures prepared before lab, information recorded while performing an experiment, analyses, calculations completed following experimental work, conclusions, and proposed work moving forward.

For each experimental activity, students formulate a hypothesis, justify the hypothesis, lay out an experimental plan to verify the hypothesis, perform the experiment, collect and analyze data, outline findings, and draw conclusions. All these activities must be documented in a lab report and the laboratory logbook.

Deliverables:

In-person circuit demo-Due at the end of each RLab session.

Lab reports-Due one week after your designated lab session.

Laboratory notebooks-Due on the day of your lab session at 11:59 pm.

**Example 2: Research Project-Design, Practical Realization, and Performance Evaluation of a Signal Amplifier**

The goal of the research project is to design, model, build, and characterize an amplifier circuit for an application of the students' choice. Students will find the project assignment on UNM Canvas in the folder named "Research Project."

In pursuit of the final goal of the research project, students perform the tasks listed below:

- Research applications that require the use of an amplifier
- Select a specific application that they will develop an amplifier for
- Determine a number of specifications that the amplifier will have to fulfill.
- Compile a list of expected findings of the project.
- Establish a design to be tested by modeling and iterate on that design.
- Realize an experimental version of the modeled amplifier.

- Characterize the amplifier and analyze collected data.
- Iterate on the design (if needed to fulfill the specifications) using both modeling and implementation, characterization, and data analysis.
- Communicate findings via a written report and a presentation.

Students work on the project in a team of 3-5 people.

Deliverables of the research project and due dates

Deliverable	Content	Example due date
<b>Team contract</b>	1-2 page team contract that clearly states, among other things, the roles and responsibilities of each member, project managing strategies, conflict resolution techniques, etc.	01/31/2025-11:59 pm
<b>Progress report no. 1</b>	Summary of the outcome of the literature review. Selection of the goal of the project, i.e., a specification of the selected application for which the team will design the amplifier and a list of required specifications. The team must also provide a rationale for their choice and justify the list of selected specifications. One per team, but submission will be individual.	03/11/2025-11:59 pm
<b>Progress report no. 2</b>	Description of the initial amplifier design, including theoretically predicted and experimentally measured performance parameters. The report should also include a list of proposed changes to the initial amplifier design and a detailed justification for those changes. One per team, but submission will be individual.	04/15/2025-11:59 pm
<b>Operating circuit</b>	In-person demonstration of the operation of the final circuit design. Demos will be individual.	4/28/2025-4/30/2025 at the designated lab time. A schedule for the demos will be agreed upon with the course assistants.
<b>Oral presentation</b>	A media presentation describing the goal, the relevant background, the implementation, and the outcome of the design project	5/6/2025 and 5/8/2025 during lecture time. A schedule for presentations will be provided as the dates get closer.

<b>Final report</b>	A written report describing the goal, the relevant background, the implementation, and the outcome of the design project. The final report will be individual.	05/09/2025, 11:59 pm
<b>Logbook</b>	A laboratory notebook. Lab notebook will be one per team, but submission will be individual.	05/09/2025, 11:59 pm
<b>Peer evaluation form</b>	A form including an evaluation of your team members. Individual assignment and submission.	05/09/2025, 11:59 pm

**Discipline: Political Science**

**Level of Immersion: Prep**

**Course: POLS 2110-Intro to Comparative Politics**

**Research survey creation and evaluation**

Students study research structures, develop survey measures, and test survey measures. For example: they can work in teams to develop survey measures of authoritarian and democratic attitudes and then. The instructor incorporate the students input into a survey using well-vetted measures. Students take the survey and then discuss it.

**Discipline: Biology**

**Level of Immersion: Partial**

**Course-BIOL302C- Genes to Genomes: Lecture and Laboratory**

Students are engaged in literature review and designing experiment for one activity; carrying out a pre-planned experiment, data collection and analysis, and presentation of results in written format for another activity.

Specifically they do a literature review on a topic within genetics and then identify a research question and propose some experiments and then present the poster as a group to the class; they also execute a pre-designed multi-week exercise (Genetics of Arabidopsis thaliana by Linda Robinson, University of Pennsylvania) where they learn various lab techniques, collect data and write it up in a written report.

Students turn in the poster project in parts: research topic and bibliography; research question, figures, introduction; first draft; final draft. They also have a peer review assignment on the first draft. They then present the poster and get individual and group points for that. About half of assignment points come from participation. Students get to rate their group members in participation on each part of the project to keep students accountable for their contributions. For the Arabidopsis project, students write the lab report in parts: Methods, Results and Discussion for Part I of experiment; Introduction; Methods, Results and Discussion for Part II of experiment; Final draft. They also have participation points along the way for each day they are doing lab work for the experiment.

**Discipline: Biology**

**Level of Immersion: Full**

**Course: BIOL301C- Molecular & Cell Biology Lab**

Students are engaged in literature review, design experiment, carry out experiment, analyze data, and present data in written and oral format. Specifically, they design, carry out, and present results based on an exercise analyzing yeast growth (based on "Using Yeast to Make Scientists: A Six-Week Student-Driven Research Project for the Cell Biology Laboratory", Lara K. Goudsouzian et al., Course Source). Students first learn how to do two of the techniques required to measure growth in their yeast cultures. They then write a project proposal where they do a mini literature review and propose their experiments, including supplies and protocols to be used. They then have two weeks to run experiments and take measurements. They have another day where TAs help them analyze data and get it ready to present in a PowerPoint to the class. Then we have a day of presentations. Students have two worksheets associated with the two days where they are learning the assays used for the experiment. They then have the written project proposal which is graded with a rubric. They then have two weeks of taking measurements, where they are mostly getting participation points. Then they have the class presentation. About half of points for the whole project come from participation points. Students get to rate their group members on participation in each part of the project to keep students accountable for their contributions. Then they each write up a final report of the project which is graded with a rubric.

**Discipline: Linguistics**

**Level of Immersion: Partial**

**Course-LING 445**

**Replicating or designing a research project**

Students create research projects which either replicate an existing study or which are inspired by an existing study. Students go through the process first to create a poster for a non-expert audience and second to write a scholarly paper for an expert audience.

**Discipline: Geosciences**

**Level of Immersion: Full**

**Course: ENVS 322L**

Students are engaged in a scaffolded exercise where they perform all analytical steps with fake data and then formulate a hypothesis about real data, read relevant background material (peer-reviewed literature), collect this data, format it for analysis, perform analyses, interpret results (consider biases), oral report summarizing their project (including things to do differently next time). Students practice being scientists by tackling a conservation biology question with quantitative techniques from ecology. The exercise forces them to learn about the biology of a specific species and its distributional ecology, practice GIS and multivariate statistical modeling skills, interpret results, and identify biases in their analyses. The oral presentation they give to the class at the end provides practice in oral and graphic (thru pptx) science communication.

Steps in performing the scaffolding exercise and their own research project are broken up into 5ish labs (~ 3hrs each) after which students turn in written responses to lab questions and/or visuals (e.g., maps) created during the lab; summative evaluation is a 10min oral presentation w/ powerpoint of their results with time for classmate audience questions - assessment of this includes evaluation by peers as well as by the instructing team.

**Discipline: Geosciences**

**Level of Immersion: Prep**

**Course: ENVS 1130-The Blue Planet**

Students practice specific skills needed in science (e.g., critical thinking/evaluation, reading primary literature, generating hypotheses, etc.) through a series of discussion posts where they receive feedback from their peers after each post. Discussion posts and responses to peers are graded as low-stakes summative assignments.