



Facilitating Laboratory Activities Series

PART 3: Implementing Inquiry-Based Learning in Lab Settings

Much of the research in the last few decades on inquiry- or problem-based learning in science and engineering education has been favorable (Ciocanel & Elahinia, 2008; French & Russell, 2002; Minner, Levy, & Century, 2010). By presenting students with a realistic problem or challenge that they must solve, inquiry-based projects allow students to be more involved in their own learning process, and helps them develop a more transferrable understanding of foundational concepts and theories (Nilson, 2010). In addition to the benefits for undergraduate students, research has shown that teaching inquiry-based laboratory activities can also help graduate students internalize important concepts (French & Russell, 2002). Below are a few suggestions on how to implement inquiry-based projects in your own laboratory sections:

Strategies	Teaching Suggestions
Consider the learning outcomes of your class	Consider how an inquiry-based project might help your students achieve the learning outcomes of your course. For example, if one of the goals of your course is to introduce students with a particular scientific process, an inquiry-based project could allow students to actively experience that process through an investigative task.
Consider the level of guidance you want to provide your students	According to Lantz & Fairfield, there are four main levels for guided-inquiry in laboratory classes: controlled , where students are given a problem, procedure, and outcome (i.e., traditional “cookbook” labs); structured , where students are given a problem and procedure, but not the outcome; guided , where students are given a problem, but not the procedure nor the outcome; and finally, open , where students determine their own problem, procedure, and outcome. It is important to note that each of the levels above demands increasing amount of preparation by TAs and instructors, as well as increasing support for students completing the task.
Include opportunities for collaboration	While laboratory activities are generally well-suited for group work between students, the increased conceptual demands of inquiry-based projects make collaboration an important aspect of these types of projects. Through group work, students learn how to effectively collaborate with colleagues in both lab activities and in the resulting writing/reporting tasks. An important consideration to make is whether you want to establish permanent groups or have students vary partners throughout the term.
Have students practice “authentic” science writing, rather than just reporting	While many students are familiar with the traditional the “lab report,” the structured nature of this genre can make it difficult for students to learn how to compose in more the realistic science writing genres they may experience in the future. An example of an “authentic” science writing task could be learning to write an effective “results” section for an article on empirical research. Hood-DeGrenier (2015) provides a step-by-step explanation on how to teach students to write a results section: see her article here . Additionally, consider having your students practice peer review by exchanging written projects with colleagues from other groups.

Adapted from: Lantz & Fairfield, 2016 & Nilson, 2010



Additional Resources

Here are a few additional resources, including virtual labs, inquiry-guided labs, simulations, and problem scenarios:

- [PhET Interactive Simulations Project](#)
- [The ChemCollective](#)
- [Biointeractive](#)
- [Virtual Courseware for Earth and Environmental Sciences](#)
- [Johns Hopkins University Virtual Laboratory](#)

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References

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