Advances in
Biotechnology & Microbiology
ISSN 2474-7637

Juniper PUBLISHERS key to the Researchers

Opinion
Volume 19 Issue 3 - April 2026
DOI: 10.19080/AIBM.2026.18.556012

Adv Biotechnol Microbiol

From Pipettes to Paychecks: Why Hands-On Lab Skills Matter in Biotech-and Why Undergraduates Need More Lab Time

Amanda Claire Brown*

Department of Biological Sciences, Tarleton State University, Stephenville, TX 76402

Submission: April 10, 2026; **Published:** April 27, 2026

***Corresponding author:** Amanda Claire Brown, Department of Biological Sciences, Tarleton State University, Stephenville, TX 76402
Email address: ABROWN2@tarleton.edu

Abstract

The biotechnology industry sits at the intersection of scientific discovery and real-world application, translating biological knowledge into therapies, diagnostics, and technologies that shape modern society, and offers an exciting (and often well compensated) career choice to bio majors. However, there is a persistent gap between what biology students are being taught in US colleges and what biotech employers expect, namely that new employees are expected to hit the ground running, with little training or supervision. While theoretical knowledge will always remain important, the increase in online degrees and the experience of the pandemic has shown us that much can be learnt from outside of the traditional campus environment. However, evidence from current literature suggests that students must develop strong hands-on laboratory skills, practical experience, and applied problem-solving abilities to be competitive in the biotech workforce; these are skills that cannot be taught online.

Keywords: Biological Sciences; Biotechnology; Biology; Biotech Workforce; Biology Education

Abbrevations: GLP: Good Laboratory Practice; BURP: Biology Undergraduate Research Program; TSU: Tarleton State University; TRIBEC: Texas Regional Industrial Biomanufacturing Education Credential; TEES: Texas A&M Engineering Experiment Station; CEUs: Continuing Education Units

Introduction

A central theme across the literature is that biology, especially biotechnology, is an applied science, requiring students to move beyond conceptual understanding into technical execution. Employers consistently prioritize candidates who can perform essential lab techniques accurately and efficiently [1]. However, lab skills are not always intuitive, like most things they require hands-on experience, practice and time to hone. Imagine learning to play the piano but without a piano to practice on - you could learn the notes and even the finger patterns, but when placed in front of a baby grand the likelihood is you would sound abysmal. In the lab foundational skills such as micropipetting, aseptic technique, and solution preparation are core competencies required for day-to-day lab work and, just like the piano, cannot be learnt fully without hands on practice. Therefore, it is not surprising that training programs that incorporate these skills have been shown to better prepare students for real-world laboratory environments, particularly when students are given opportunities to practice and troubleshoot independently [2].

One of these basic techniques is precise pipetting, which is essential for ensuring reproducibility and accuracy in experimental results. Knowing what the first stop of a micropipette, versus the second, feels like is something that needs to be experienced to be appreciated, and not being able to identify which is which means that one's pipetting is going to be inaccurate, and most likely will result in experimental failure. As highlighted by Sequence Biotech [3], familiarity with techniques such as PCR, gel electrophoresis, and ELISA is increasingly expected, as these methods are widely used in both research and industrial settings. Plus, technical abilities reflect a broader expectation within the biotech industry: that employees must be capable of producing reliable, high-quality data.

However, technical skills alone are not sufficient to be functional in the biotech lab. The ability to design experiments, interpret data, and troubleshoot problems is equally important. Biotechnology professionals must think critically and adapt when experiments do not go as planned. But few classes offer the ability for students to consider what consists as experimental design, including the need for replicates, and the requirements for biological- and technical controls. According to recent analyses, employers seek individuals who can bridge the gap between theory and application by demonstrating strong analytical and experimental design skills [4]. This aligns with findings that emphasize the importance of engineering-style thinking in biotechnology, where students must understand not only how to perform experiments but also how to optimize and scale processes for industrial use [5].

In addition to laboratory and analytical skills, the biotech industry increasingly demands interdisciplinary and professional competencies. Communication, teamwork, and documentation are essential in collaborative lab environments and highly regulated industries. Proper record-keeping, for example, is a fundamental aspect of Good Laboratory Practice (GLP) and ensures reproducibility and accountability. Furthermore, emerging trends indicate a growing need for data literacy and bioinformatics skills, as modern biotechnology relies heavily on large datasets and computational analysis [6]. Despite these clear expectations, many undergraduate programs still rely heavily on structured laboratory exercises that limit opportunities for independent thinking and problem-solving. While such labs introduce basic techniques, they often fail to replicate good experimental design, or account for unpredictability of real research or industrial work. For example, while it may sound good that students are getting hands on experience in PCR, what do they really learn from setting up a single tube reaction once and then running that on a gel? How realistic is that experience with real-world lab work? When would we ever just set up a single PCR reaction? Where are the controls? Where are the replicates? In some ways we are doing our students a disservice with these limited experiences as they give them a false sense of what constitutes setting up an experiment. Plus, we are teaching them the requirements of experimental design in theory, but in practice they are performing one experiment, once - which contradicts everything they have learnt!

Undergraduate research projects, especially those for class credit, are an excellent way for students to get more real-life type experience. However, it is not a small commitment on behalf of the professor to have undergrads in the lab - the time to train them and to get them competent is often off-putting, and typically just as they start obtaining robust data the semester ends. In addition, different universities have very different time allocations for undergraduate research - for example, a quick internet search reveals that San Franscisco State University's Biology Undergraduate Research Program (BURP) expects a commitment of between six and 20 hours per week, whereas University of North Carolina's Biology department requires 10-12 hours per week. Yet William & Mary College suggests six hours per week, per credit, and University of Michigan (LSA) four-to-five hours per week, per credit. My own institution (Tarleton State University) expects a time commitment of nine hours a week for three-credits. Thus, it is very difficult for prospective employers to gauge how much lab experience a student may have based research per semester or even on the course credit gained, especially if an employer is basing their estimation on their own undergrad research experience.

TRIBEC (Texas Regional Industrial Biomanufacturing Education Credential, https://tribec.co) [7] offers hands-on lab experience in biotech, resulting in completion certificates and Texas A&M Engineering Experiment Station (TEES) continuing education units (CEUs). In addition, TRIBEC partners with community colleges and universities offering biotechnology programs throughout Texas, ensuring there is a level of uniformity in the techniques being taught and the hands-on time spent in the lab across different institutions. TRIBEC aims to provide industry-aligned training, credentialed talent, and collaborative opportunities to strengthen Texas' biomanufacturing future.

With this in mind, educational institutions should emphasize research-based learning, internships, and project-based coursework, which allow students to engage in authentic scientific inquiry. Internships, in particular, provide invaluable exposure to industry practices, equipment, and workflows, helping students transition more effectively into professional roles. Several universities have started integrating internships as part of their degree courses, allowing students to gain course credit while taking them. However, many students still fail to see the added value of an internship, especially if it results in a postponement of their expected graduation date. In the UK 'Sandwich degrees' offer a year in industry, which is often paid and were first developed in the 1950s. This type of degree is also offered in France, Australia, Denmark and several French speaking African countries. As well as providing invaluable experience, internships often lead to job offers; Genentech, for example, has a vibrant internship program, and often hires ex-interns after graduation.

Conclusion

In conclusion, the evidence strongly supports the argument that hands-on laboratory experience is essential for biology students seeking careers in biological research, especially in biotechnology. Skills such as aseptic technique, pipetting accuracy, and familiarity with core experimental methods, form the foundation of industry readiness. Equally important are the analytical, problem-solving, and professional skills developed through applied learning experiences. As the biotech industry continues to evolve, colleges must adapt their curricula to ensure that graduates are not only knowledgeable but also capable of performing effectively in real-world laboratory settings. Ultimately, the path from classroom to career is built not just on what students know, but on what they can do.

How to cite this article: Amanda Claire Brown. From Pipettes to Paychecks: Why Hands-On Lab Skills Matter in Biotech-and Why Undergraduates Need More Lab Time. Adv Biotech & Micro. 2026; 19(3): 556012. DOI: 10.19080/AIBM.2026.18.556012

References

1. Labiotech.eu (2023) What are the necessary skills to work in the biotech industry?
2. Bioinnovation Course Study (2023) Course-based research experience in biotechnology education.
3. Sequence Biotech (2023) Biotech careers: Skills in demand.
4. Biotecnika (2023) Biotech industry skills – These 6 skills you ought to have.
5. Science Direct (2023) Development of engineering skills in students of biotechnology: From laboratory to industry.
6. Technology Networks (2024) What skills do the next generation of scientists need?
7. TRIBEC (Texas Regional Industrial Biomanufacturing Education Credential)

DOI: 10.19080/AIBM.2026.18.556012

How to cite this article: Amanda Claire Brown. From Pipettes to Paychecks: Why Hands-On Lab Skills Matter in Biotech-and Why Undergraduates Need More Lab Time. Adv Biotech & Micro. 2026; 19(3): 556012. DOI: 10.19080/AIBM.2026.18.556012