Designing Neuroinclusive Chemistry Learning Environments Course Adaptations to Minimize Accommodation Requests

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Problem / Context

Chemistry courses in higher education often rely on reactive, individualized accommodations that inadvertently reinforce barriers for neurodivergent (ND) students. This pattern reflects broader systemic issues in STEM: although disabled individuals make up 10% of the U.S. workforce, they represent only 3% of the STEM workforce (National Center for Science and Engineering Statistics, 2023). For many ND students, the barrier is not the content itself but instructional structures that assume uniform executive functioning, processing speeds, and familiarity with unspoken academic norms.

At a college serving exclusively ND learners—including autistic students and those with ADHD, dyslexia, anxiety, and other cognitive profiles—Landmark College faculty observed firsthand how conventional STEM practices can create obstacles unrelated to learning outcomes. Scholarship on disability identity highlights that deficits-based framing and inconsistent accommodations can impose psychological and structural burdens on disabled students (Dirth & Branscombe, 2018). Likewise, research on the hidden curriculum describes how unspoken expectations disproportionately disadvantage students who have not been socialized into traditional academic systems (Orón Semper & Blasco, 2018).

Guided by this research, a central design question emerged:

How might a chemistry course be intentionally structured so that most students do not need to request individualized accommodations at all? Over five and a half years, Landmark College faculty taught 28 classes serving 127 unique students, with enrollments ranging from two to twenty-two. Of these, only six students requested formal accommodations, and all reported that their needs were met through existing course policies. The remaining 121 students—who would have been eligible for accommodations as neurodiverse learners—did not find it necessary to request them.

What Was Done

To create a more accessible and neuroinclusive chemistry course, instruction was redesigned around three interconnected areas: predictable structure, Universal Design for Learning (UDL)-aligned multimodal instruction, and strengths-based Course-Based Undergraduate Research Experiences (CUREs).

UDL as Foundation. UDL served as the foundation for anticipating learner variability and embedding multiple means of engagement, representation, and expression (CAST, 2025; Meyer et al., 2024). Complementary principles from inclusive design underscored the importance of usability and systems-level accessibility rather than individualized retrofitting (Waller et al., 2025).

Predictable Structure and Executive Function Supports

The course adopted a stable weekly rhythm, transparent assignment expectations, and a 48-hour grace window for all due dates. Built-in catch-up days and required office-hour meetings supported time management and self-advocacy—skills often masked by executive functioning challenges. By reducing unnecessary unpredictability, the design addressed a key barrier for many ND students.

UDL-Aligned Multimodal Instruction.
Each module included paired readings with captioned videos, guided notes, annotated slides, and hands-on or simulated activities. Students could select the modality that best aligned with their cognitive and sensory needs, consistent with UDL's flexible access recommendations (CAST, 2025).

Adapted CURE-Based Laboratory Experiences

CUREs provided students with authentic inquiry opportunities. Prior studies demonstrate that CURE-based models increase engagement, scientific identity, and skill development, especially when students pursue questions tied to real-world relevance (Bhattacharya et al., 2020; Coppock et al., 2017). For ND students, these flexible, interest-driven research experiences supported creative problem solving and sustained attention.

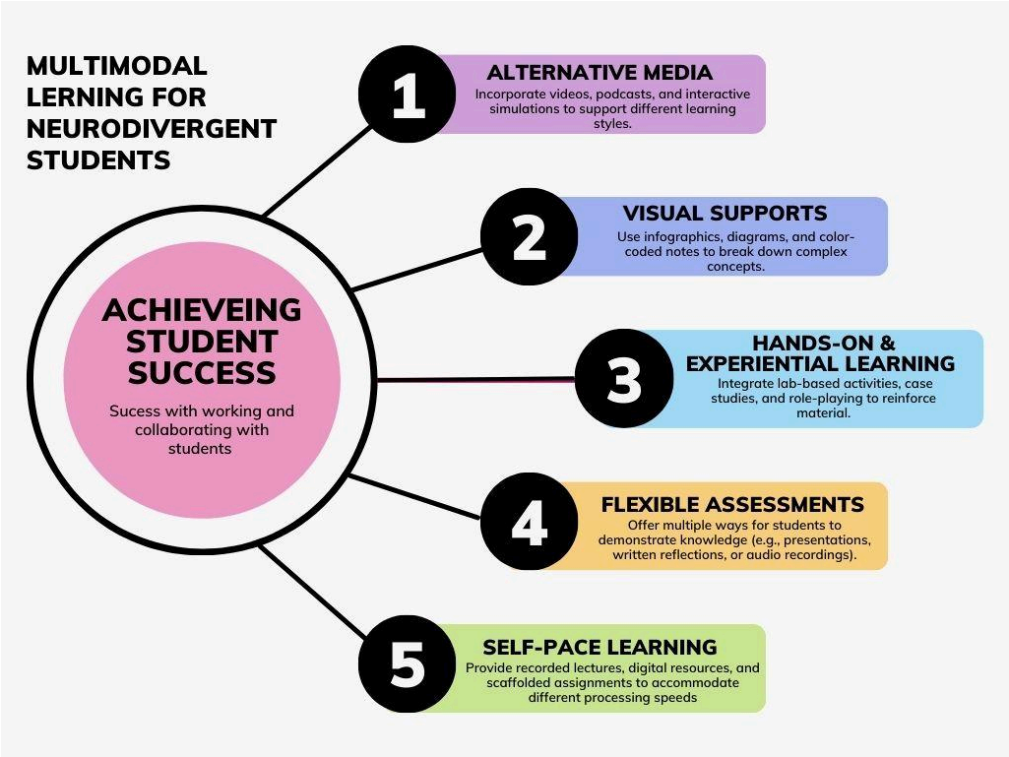
Faculty explicitly articulated expectations that are typically left unspoken: how long tasks might take, what successful work looks like, and how to communicate professionally. Making these norms transparent helped reduce hidden curriculum barriers known to undermine confidence and belonging (Orón Semper & Blasco, 2018).

Student Perspective

Figure 1 reflects a student-centered perspective on what fosters success in neuroinclusive learning environments.

Figure 1

Illustrates key strategies for multimodal learning highlighted by a Landmark College student



These elements were identified through direct feedback and observations of student engagement, emphasizing approaches that reduce cognitive load, increase autonomy, and affirm diverse learning preferences. By prioritizing flexibility and transparency, these strategies align with Universal Design for Learning principles and help create conditions where students feel empowered rather than accommodated.

What Was Learned

Proactive Design Nearly Eliminated the Need for Accommodations.
Only nine formal accommodation requests were made across five and a half years, indicating that structural supports—rather than individualized adjustments—were sufficient for most learners.

Student Engagement and Self-Advocacy Increased

Students participated more consistently in office hours, asked clarifying questions earlier, and demonstrated increased metacognition. These behaviors align with research showing that transparent and affirming learning environments foster stronger disability identity development and agency (Dirth & Branscombe, 2018).

CUREs Deepened Learning and Belonging

Students described CUREs as the most meaningful part of the course, noting how authentic inquiry allowed them to see themselves as capable chemists. This aligns with evidence demonstrating that research-based lab experiences improve attitudes, skill development, and participation in chemistry (Bhattacharya et al., 2020; Coppock et al., 2017).

Executive Function Supports Strengthened Academic Performance.
Predictable structure, pacing tools, guided notes, and multimodal materials helped students stay engaged and organized. These findings support inclusive design principles focused on usability and reduced cognitive load (Waller et al., 2025).

Implications for Practice

Several implications emerged for STEM educators seeking to design more equitable learning environments:

1. Flexibility supports rigor. When intentional, flexibility fosters deeper learning and expands access without compromising academic expectations.
2. UDL benefits all learners. Offering multiple entry points into content supports diverse cognitive and sensory profiles (CAST, 2025).
3. CUREs broaden participation. Inquiry-based research experiences, especially when interest-driven, help ND students build scientific identity (Bhattacharya et al., 2020).
4. Transparent instruction reduces hidden barriers. Naming expectations helps mitigate inequities tied to hidden curriculum structures (Orón Semper & Blasco, 2018).
5. Executive function supports should be built into design. Predictable routines, self-pacing tools, and structured guidance should be viewed as essential components of course design.

Practical Strategies for Neuroinclusive Course Design

Barrier	Intervention	Additional Considerations
General Executive Function Challenges	Flexible Deadlines	Deadline flexibility should be structured in some way. For example, providing a suggested and hard deadline. Putting "placeholder" zeros to communicate students up to date grade is also recommended.
Effort	Opportunity for Drafts	Giving students the opportunity to revise formative assessments can lower anxiety and make them more likely to complete assignments. Some students would rather get a "zero" on an assignment with no judgement rather than a true grade with judgement.
Activation & Focus	In Class Assignments	There are many reasons why students may struggle to complete assignments outside of class. Providing class time to work on assignments (even getting started with them) can minimize the activation barrier that some students have.
Activation & Memory	Alternative Ways to Engage with Content	Some students may struggle with reading comprehension for a variety of reasons. It can be useful to pair reading assignments with videos. It is recommended videos have embedded questions. Completing videos with direct assessments may also lower the activation barrier.
Emotional Regulation: Trust	Build Relationships	Ask students "Is there anything you think I should know about you that may affect your academics?" This is a non-confrontational way to encourage students to disclose disability status, but also other factors that may impact their success, such as jobs or family obligations.
Emotional Regulation: Grade Anxiety	Transparency	Grades provide students with a straightforward way to know where they stand in classes. Placeholder "zeros" can be used to communicate missing work, but it is recommended to clearly communicate with students that they are still able to

		submit missing work and the grade is not an accurate representation of their content knowledge due to missing assignments.
Working Memory: Extended Time on Tests	HiFlex Exams	Provide students with the option to complete exams either in-person or as a take home. Take home exams with no structure can cause barriers for students with executive function challenges, so it is recommended to also give the option for structured time to complete assignments.
Memory & Emotion	Align assessments with learning objectives	Consider what is being assessed and the underlying skills or tasks that are not being assessed. Encourage students to identify and utilize their strengths and make efforts to minimize tasks that are not being assessed.

Conclusion

This practitioner experience demonstrates that chemistry courses can be intentionally designed to support neurodivergent learners through proactive, inclusive strategies grounded in UDL, inclusive design, and research on disability identity and hidden curriculum. By embedding predictability, transparency, and multimodal engagement into course structures, instructors can create environments that reduce reliance on reactive accommodations and foster stronger engagement, confidence, and belonging in STEM. This model is readily adaptable to a wide range of STEM disciplines and offers a replicable framework for designing environments that affirm neurodivergent identities while promoting equitable participation.

References

Bhattacharya, R., Harvey, J., & Longley, M. (2020). *Course-based research: A vehicle for broadening access to undergraduate research in the twenty-first century. In Science education and research: An engagement of undergraduate and graduate science students and faculty (pp. 21–38).* Springer.

CAST. (2025). *Universal Design for Learning guidelines version 3.0*. https://udlguidelines.cast.org/

Coppock, P., Park, S. H., Paredes, J., Pennington, R., Pursell, D. P., Rudd, G., ... & Tsoi, M. Y. (2017). Enhancing research skills and attitudes in undergraduate organic chemistry with a course-embedded undergraduate research experience via green organic synthesis. *Journal of Laboratory Chemical Education*, *53*, 41–47.

Dirth, T. P., & Branscombe, N. R. (2018). The social identity approach to disability: Bridging disability studies and psychological science. *Psychological Bulletin*, *144*(12), 1300–1324.

Meyer, A., Rose, D. H., & Gordon, D. T. (2024). *Universal design for learning: Principles, framework, and practice.* CAST Professional Publishing.

National Center for Science and Engineering Statistics. (2023). *Diversity and STEM: Women, minorities, and persons with disabilities.* National Science Foundation.

Orón Semper, J. V., & Blasco, M. (2018). Revealing the hidden curriculum in higher education. *Studies in Philosophy and Education*, *37*(5), 481–498.

Waller, S., Goodman-Deane, J., Bradley, M., Hosking, I., & Clarkson, J. (2025). *Inclusive Design Toolkit: What is inclusive design?* https://www.inclusivedesigntoolkit.com/whatis/whatis.html

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