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Commentary

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Using the Universal Design for Learning Approach in Science Laboratories To Minimize Student Stress

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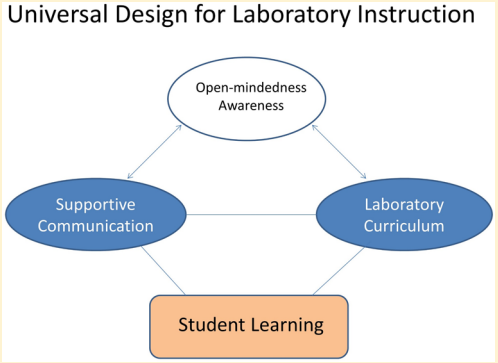
Supporting Information

ABSTRACT: This commentary discusses how the principles of universal design for learning (UDL) can be applied in the science laboratory with an emphasis on assisting students who experience stress in the laboratory environment. The UDL approach in the laboratory is based on three elements: open-mindedness, supportive communication, and analysis and adaptation of laboratory curriculum. "Supportive communication", a novel element of our approach comprising interaction methods adapted from counseling therapy, is introduced. A brief discussion of a workshop for chemistry faculty and graduate students on the UDL approach is presented.



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INTRODUCTION

Common course objectives of general and organic chemistry laboratories include problem solving, group collaboration, active participation, and understanding laboratory content. A study completed by DeKorver and Towns[1] found the majority of students were primarily driven by topical goals including completion of the laboratory experiment as soon as possible and fulfilling the necessary requirements to achieve credit for the course. Galloway et al.[2] conducted a qualitative study which found students used the words frustrated, confused, and nervous to describe their chemistry laboratory experience, none of which are conducive to the mastery and understanding of chemistry laboratory content at the college level. Additional research conducted by Kurbonoglu and Akim[3] found that assisting students through their stressful and anxious experiences in the laboratory setting will likely enhance the learning experience and generate more positive attitudes toward chemistry. In addition to the general student perception of the college laboratory experience, many students have difficulties relating to others and/or processing information, especially those experiencing mental health issues. Since many laboratory activities involve a combination of social, physical, and intellectual components within a time constraint, stress is inevitable. (See Figure 1)

The National Alliance on Mental Illness's (NAMI) "College Students Speak" article[4] compiled data collected from individuals diagnosed with a mental health condition who are currently enrolled in college or were enrolled in college within the past five years. The survey asked a variety of questions related to their experiences living with a mental health

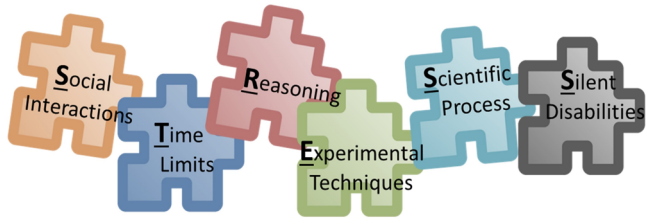

Figure 1. Elements of STRESS in the science laboratory experience.

condition while attending college. Consider these findings: 64% of those who stated they did not graduate and are no longer attending college claimed a direct relationship with a mental-health-related reason. Additionally, 45% of the students responding did not receive support or accommodations, and 50% of students did NOT disclose mental health conditions to their college. The statistics at our university (a residential state university with about 21,000 undergraduate and graduate students) illustrate how prevalent these issues are. Two-thirds of the 650 students who registered with the Ball State Disability Services office in 2014 were diagnosed with "invisible" or "silent" disabilities, which included learning disabilities, attention deficit disorders, and psychological disabilities, and diagnoses on the autism spectrum.[5] According to the Substance Abuse and Mental Health Services Administration (SAMHSA), 20.1% of adults ages 18−25 experienced a mental illness within

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the past year, and 15.3% of those cases were classified as a mental illness that excludes "serious mental illness".[6] Given the widespread prevalence of students with mental health issues, we must realize that many students have difficulty organizing and completing the tasks which are assigned in the science laboratory setting.

The majority of faculty and staff are not adequately trained to understand or recognize student issues which may be defined by the Diagnostic and Statistical Manual of Mental Health Disorders,[7] and of course this is not the expectation for science educators. That being said, Norman et al.[8] reported that university science educators consistently shared a primary concern of "inadequate preparation and training regarding teaching science to students with disabilities". If the goal of an educator is to assist students with the learning process, it is necessary to attain a better understanding of the stress which students experience, how those issues may manifest themselves in the laboratory, and the support we can provide.[9]

New and intriguing science laboratory approaches geared toward enhancing the motivation for all students, including students with disabilities, are being steadily integrated into the college laboratories. Neely[10] has implemented technology support and other assistive strategies for students with physical and visual impairments in the science lab setting, and all faculties clearly recognized the value of empowering each student throughout the process. Reglinski[11] presented pictoral representations of chemistry concepts as test questions requiring students to "give a detailed explanation of the diagram", and as a result there was a significant increase in student performance, including those with learning disabilities. Focusing on inclusive and innovative lab procedures for students with disabilities, Lunsford and Bagerhuff[12] implemented successful laboratory experiences through workshops and applicable laboratory modifications during summer workshops. We propose that all faculty continue to integrate inclusive and empowering laboratory approaches through a universal method of design approach as the foundation for student learning.

As clarified by Riviou et al.,[13] the philosophy behind the universal design for learning (UDL) involves providing many curriculum delivery formats and teaching strategies in order to maximize the learning and engagement of students with a variety of learning styles and needs, while benefiting everyone in the process. Additionally, UDL embraces the idea that a range of assessment techniques can provide students with several opportunities to demonstrate their knowledge. A list of guiding principles has been constructed in a publication by Mullen and Bernachio,[14] which emphasizes the importance of the creation of a welcoming and inclusive learning experience and communication of perceptible information while maintaining high expectations for all students. The UDL approach is further supported by Novak's theory[15] of meaningful learning. Helping students overcome emotional barriers to learning is a necessary step toward achieving the organizational effort and emotional commitment required to integrate new and existing knowledge.

We have proposed a practical framework for the application of UDL that is focused on reducing stress and disconnection in laboratory environments. This UDL approach is based on three elements: (i) open-mindedness; (ii) supportive communication; and (iii) analysis and adaptation of laboratory curriculum. As past chair, one of us (P.L.L.) sought advice from another one of us (D.K.M.) who serves as lab instructor and who has degrees in both chemistry and counseling psychology. This commentary aims to provide an introduction to some of the specific mental health issues that students may face as correlated with observations in the classroom, present a pathway for supportive communication, and provide an improved learning environment that is more inclusive, motivating, and exciting for students in the chemistry laboratory.

OPEN-MINDEDNESS

The first requirement toward understanding how to deal with stress related problems is simply demonstrating open-mindedness, *an awareness of the possibility that a problem behavior exhibited in the classroom or laboratory may be due to a reason other than laziness or lack of preparation.* While laboratory instructors are not qualified to make a diagnosis, effective instructors can try to understand what might be inhibiting a student's concentration, communication, or processing so they can find a mechanism for the student to benefit from the laboratory experience.[8]

Mental Health Challenges

Educators such as Nilson[16] clearly explain that college students aged 18−22 have not yet reached a defined maturity, and thus are more susceptible to emotional turbulence in the midst of challenging situations such as a new and confusing laboratory environment. Some of these mental health challenges include the following.

- Misreading information: Poor grasp of abstract concepts.
- Screening out environmental stimuli: an inability to block out sounds, sights, or odors that interfere with focusing on tasks. Limited ability to tolerate noise and crowds.
- Sustaining concentration: restlessness, shortened attention span, distraction, and difficulty understanding or remembering verbal directions.
- Handling time pressures and multiple tasks: difficulty managing assignments, prioritizing tasks, and meeting deadlines. Inability to participate in multitask work.
- Interacting with others: difficulty getting along, fitting in, contributing to group work, and reading social cues.
- Responding to negative feedback: difficulty understanding and correctly interpreting criticism or poor grades. Personalization or defensiveness due to low self-esteem.
- Responding to change: difficulty coping with unexpected changes in coursework, such as changes in the assignments, due dates, or instructors. Limited ability to tolerate interruptions.
- Severe test anxiety: the individual is rendered emotionally and physically unable to take an exam.
- Either pays too little attention to details or focuses on them too much. Works slowly.
- Trouble summarizing, trouble with open-ended questions on tests, and weak memory skills.
- Medication side effects: drowsiness, fatigue, dry mouth and thirst, blurred vision, hand tremors, slowed response time, and difficulty initiating interpersonal contact.

Additionally, depression, anxiety, attention deficit−hyperactivity disorder, obsessive−compulsive disorder, and autism have the potential to directly inhibit the communication and mental processing ability of the student. To have a brain that processes information differently can be a very challenging experience. Often students who are experiencing these challenges are inaccurately judged to have a significant lack of concentration and determination, and authors including Stanley and

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Manthorp[17] challenge all educators to assist these students without negative judgment while still maintaining the educational standard in place.

SUPPORTIVE COMMUNICATION

In the laboratory setting students are learning new methods in an attempt to physically manipulate new materials in the context of a new environment while utilizing new tools throughout the process. These students are being taught by an instructor with a very solid understanding of the methods, materials, procedures, environment, and tools. This situation has the potential to lead to negative judgments, overgeneralizations, inaccurate assumptions, discomfort, and frustration. Rather than exhibit frustration to the student and their lab partners, we suggest that instructors practice communication techniques that we term *supportive communication.*

Supportive communication initiates and maintains a welcoming, unbiased environment through careful presentation of voice and body language, reassurance with name recognition and compliments, and calm identification of issues that need remediation. By analogy, instructors can improve interactions with students by practicing supportive communication. Supportive communication methods will *facilitate the transfer of information in a learning environment without tension and additional stress. Choice Theory in the Classroom*[18] offers an excellent explanation of the theoretical purpose of open communication which includes motivating quality work and self-evaluation. Supportive communication is an essential and teachable element of UDL, and its application will assist both the instructor and the student.[13,14]

Demonstrate Respect and Encouragement for All Students

The steps below describe the elements of supportive communication; examples of instructor comments are *italicized.*

- Respectful interaction is only possible with an open body posture, open hands, appropriate eye contact, and a gentle voice.
- The most helpful forms of encouragement often require patience and time as students assess the situation.
- Using students' names in interactions is respectful and empowering for students.
- Give positive feedback to students who are **asking questions**, **solving problems**, **preparing for class**, **understanding the material**, **helping other students**, and **efficiently completing tasks** (see Figure 2).
- Communicate in a way that allows your students to understand your message.

Avoid using complicated and challenging language*: The construction of this simple distillation apparatus is unstable due to inappropriate placement of Keck clips, and furthermore, it is incapable of initiating evaporation due to inadequate application of heat because you have initiated the fault switch in your ac outlet.*
Use straightforward and simple language*: If the Keck clips are placed here and here, the glassware will be supported. Also, keep an eye out for the reset button on this outlet to make sure the heat regulator has power.*

- Communicate in a way that is respectful and encouraging to your students, but still maintains assertiveness in your instructions

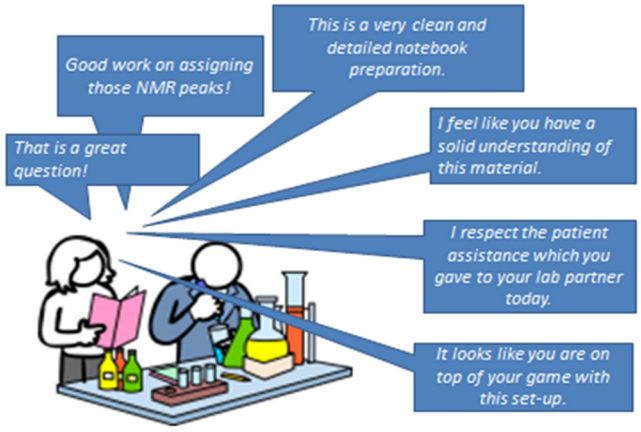

Figure 2. Giving positive feedback is a simple element of supportive communication.

Avoid using judgmental statements*: You set up an unstable apparatus because you did not stabilize the condenser with a clamp.*
Use neutral language instead*: This condenser needs to be stabilized with a clamp.*

Encourage Students to Share Their Perspective, and Lead by Example

These suggestions can elicit interactions with students, promoting supportive communication; examples of instructor comments are *italicized.*

- It is often helpful to initiate communication with a positive or neutral statement, followed by guided questions or reassuring statements. Some students may need an invitation to voice their questions when they do not fully understand a specific procedure within the lab.

You both seem to be well-organized. Do you have any questions about your lab results today?
How are you doing with the separation techniques?
This is an unexpected result. How do you think we should assess this data?

- Invite students to meet with you to discuss disability-related accommodations and other learning needs. Also, present this invitation on the syllabus and within the course introduction. Respect disability-related requests and accommodations. Never draw undue attention to differences or share private information about a disability.

But what about the times when the student is annoyed by their grade, they want to start an argument, they are disrespectful, they just do not seem to be prepared for class, or they are frustrated by inaccurate beliefs or assumptions? Instead of feeling personally offended by a disagreement, imagine that you were in the exact same situation as the student and avoid operating in the defense mode. First, invite the student to talk about the academic issue after lab in a private setting, and encourage the student to share their perspective. Focus on respecting and fully understanding the perspective which they are sharing. Ask yourself: What does the student want or need in this situation? What is inhibiting the student from achieving this goal? What can I do to assist the student? Second, calmly clarify that you respect the student's perspective by sharing your interpretation of their view. Once the student feels that they have been heard and understood, *then* share your perspective with them in a respectful manner.

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The college classroom setting is challenging, but the laboratory experience can be daunting for students. As described by Fansworth[19] in the context of dispositions of the young adult, instructor intimidation and annoyance will result in student distress, hostility, and feelings of inadequacy. As instructors increase their understanding of the challenges students are facing through open-mindedness and supportive communication, they can better help students achieve the goal of understanding (not just completing) the laboratory experience. The benefits of supportive communication to the student can be therapeutic as well. A 1979 study known as the Vanderbilt Psychotherapy Research Project showed that college students with depression, anxiety, and social introversion who underwent therapy with untrained college professors, chosen for their ability to form good relationships, showed the same quantitative improvement after 18 sessions as those students treated by experienced and trained psychotherapists.[20] The researchers concluded that college professors, untrained in therapy techniques, can form meaningful relationships with students that are therapeutic. While that is not the goal of our advocacy of supportive communication, the study illustrates the value of an empathic and respectful listener.

ELEMENTS OF LABORATORY EXPERIENCE THAT REDUCE STRESS

Open-mindedness and open communication represent the doorways of opportunity to examine and understand the student's laboratory experience. This allows the discovery of new applications to motivate students to learn and grow through the process of their science course. The UDL philosophy is an easily accessible resource[21] which challenges optimization of the delivery of **what** is learned, the explanation of **why** the content is important and applicable, and the examination of **how** it is being assessed so that all students can benefit. The Washington Do-It Center,[22] the Canadian Mental Health Association,[23] and the book titled *Science Teaching in Inclusive Classrooms: Models and Applications*[24] are excellent resources for exploring UDL applications to optimize physical and mental accessibility to the laboratory experience for all students, including those with disabilities. In order to assess the effectiveness of current lab curriculum, lab instructors should willingly seek to answer a few general questions.

1. Do all students have access to what must be learned in your *physical laboratory space*?
2. Are you delivering *the laboratory curriculum* in a variety of ways so that all students have access to what must be learned? That is, are course materials, procedures, prelab instruction, and experiments relevant and engaging?
3. Are you able to introduce and accept *multiple assessment pathways* for all students to express how they know the information?

Access to Learning in the Physical Lab Space

In considering the physical environment of your lab space, instructors need to be cognizant of lab partner assignments (when there are options), as students with issues related to social interaction should be grouped with those who will allow them to participate and use their strengths as well as help with areas of difficulty. We suggest making students aware of time limits before and during laboratories, and warning students a few minutes before the scheduled ending of an activity. This eases transition from one activity to another and could assist those with issues related to time and to making changes. Maintaining a clean, organized laboratory helps those students who already struggle with organization and contributes to laboratory safety. See Box 1 for suggestions for adapting the physical lab space.[23,24]

Box 1. Suggestions for Examination of Physical Lab Space

- Make sure students have a clear line of sight to the instructor and visual aids.
- Minimize distractions including clutter, flashing lights, and excess noise.
- Clearly outline any class-related transitions, and discuss any concerns.
- Be flexible in assignment of lab partners.
- Train teaching assistants to be responsive to students and provide feedback and support.
- Use large print to clearly label controls on lab equipment and other educational aids, using symbols as well as words.
- Label safety equipment in simple terms, in large print, and in a location easily viewable for everyone.
- Provide straightforward, simple printed directions for operation and use of equipment.
- Consider preferential seating modifications for reduced distractions and frequent opportunities for breaks, especially during stressful situations or long laboratories.

Multiple Approaches to Presenting the Lab Curriculum

Most of us use demonstrations and chalk talk for prelab lectures, but we might also consider videos, PowerPoint presentations, and physical models to try to reach students who have better auditory, visual, and kinesthetic skills. A variety of delivery methods will increase your chances of reaching students who have trouble processing information. A simple thing like using LARGE print on handouts and not cluttering the board goes a long way. One of the most important points in delivery of curriculum is to ask or require students to work on assignments prior to arriving in lab. They are better prepared for the task and the laboratory goes smoother. See Box 2 for suggestions for adapting the lab curriculum.[23,24]

Offering Multiple Assessment Pathways

Consider the use of electronic lab notebooks or a report template. This will assist students with organizational issues. Finally, consider assessing group and cooperative performance in addition to individual achievement. If done correctly, research shows that group work increases the learning of the individuals in the group. See Box 3 for suggestions for providing multiple forms of assessment.[23,24]

Ensuring the application of UDL to lab space, curriculum, and assessments for each laboratory exercise or experiment would aid in addressing stress and discontent previously discussed. The last bullet points on each of the previous lists are special accommodations that an instructor might consider if something beyond the universal approach is needed. However, what if UDL methods are still not enough, and students need special accommodations? As Grandolfo[25] elegantly suggested, it would be best to identify any "lurking alligators" as soon as possible. Instructors should examine whether current methods of instruction are integrally linked to the purpose of the lab course. What techniques are absolutely necessary to learn? Decide and list the specific knowledge, principles, concepts, and skills that must be mastered by students. Instructors should vet

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Box 2. Suggestions for Examination of the Lab/Prelab Curriculum

- Use materials that are well-organized; emphasize important points.
- Consider technology-based materials as well as handouts that provide background information, vocabulary, practice exercises, and other cognitive supports.
- Put the laboratory lesson in context.
- Use multiple modes to deliver content: PowerPoint, presentations, chalk talk, video, and demonstrations, as well as printed formats.
- Allow students to work on assignments before the prelab instruction.
- Ensure that lab materials, notes, and other information resources are engaging.
- Provide adequate time for equipment instruction and completion of the laboratory.
- Consider allowing peer note-takers, recording of prelab instruction, additional lab modifications to resolve safety concerns, selection of a carefully chosen lab partner to facilitate completion, and additional time for completion of the laboratory.

Box 3. Suggestions for Examination of Laboratory Assessment Pathways

- Use materials that are well-organized; emphasize important points; consider technology-based materials as well as handouts that provide background information, vocabulary, practice exercises, and other cognitive supports.
- Encourage students to work on assignments before the experiment begins, when possible.
- Provide a syllabus with clear statements of expectations, assignment descriptions, and deadlines. Include assessment methods, dates, and grading rubrics.
- Assess group and cooperative performance, as well as individual achievement.
- Include a variety of assessment activities: exercises, oral presentations, posters, written short reports, long reports, and portfolios.
- Have an authentic evaluation from an outside faculty or professional.
- Consider deadline extensions, alternative evaluation methods, and extended test time.

these with other members of their discipline who teach the course and the department's curricular affairs committee, as master syllabi may need to be altered.

The preparation and enthusiasm of teaching assistants (TAs) in the lab should also be considered. In the event that any professor, instructor, or TA is not fully invested in implementing accommodations, it may be beneficial to present the American Chemical Society (ACS) publication titled *Teaching Chemistry to Students with Disabilities: A Manual for High Schools, Colleges, and Graduate Programs*[26] which clearly specifies the laws and theories regarding implementation of appropriate accommodations in the laboratory environment. It is beneficial for everyone, including the TAs, to be fully aware of all of the details relevant to the lab, including course material and potential teaching barriers. As clarified within the publication by Pence et al.,[27] TAs should fully understand their responsibility to attentively assist students, including those with disabilities, while allowing the student to fully experience the chemistry experiment. Intensive training programs,[28] consistent meetings, and example modeling are often necessary to ensure that TAs are performing to the teaching level desired by the department. These practices allow for adequate resources for problem recognition, discussion regarding potential challenges, assistance in overcoming current challenges, and an opportunity to motivate TAs to motivate their students to understand the laboratory content.

Safety concerns must be part of the discussion as to how to best accommodate persons with any kind of disability in the laboratory. However, an extensive study conducted by Swanson and Steere[29] indicated that persons with physical disabilities pose no greater safety threat than those without. While safety studies on those with mental health issues in the science laboratories have not been found, Steere[30] found the main contributing factors initiating student laboratory accidents include inadequate work space, overcrowding, poor teacher preparation, and inadequate safety training. Many of these issues can be addressed in the examination of physical laboratory space and proper safety training of instructors. However, if inattention and distraction is observed in a student, experiments can be modified (and should be) to address safety concerns. Severe concerns may be addressed at the department safety or curriculum committee, if necessary.

UDL IN THE LABORATORY INTERACTIVE WORKSHOP

The authors facilitated a workshop (see Supporting Information) for their department faculty, staff, and TAs to introduce UDL. The goals of the workshop included improving the success of instructor interactions with students and the effectiveness of the lab curriculum. First, the prevalence and types of mental health issues seen on the college campus were presented. These issues were then related to their potential effects on student learning. The definitions and actions regarding open-mindedness and supportive communication were introduced. Attendees then broke into small groups where they were asked to analyze different types of student problem behavior (i.e., disorganization and continually arriving late for lab). They shared how they felt when they witnessed the behavior, and they discussed their likely statement to students in that situation. Group members each proposed an alternate (mental health) reason for the example student behavior, and proposed how they might respond in a more helpful way using supportive communication. Each group shared their scenario with the full workshop, and then a brief discussion followed. Finally, motivation to examine the laboratory curriculum with UDL in mind was presented. Each attendee received a packet of materials, along with a pre- and post-test survey.

The results of the survey indicated that after the seminar attendees showed statistically significant improvement in understanding the supportive communication approach (called the universal design approach for communication in the workshop), in being able to define common potential mental health issues, in knowing how to examine the delivery of the lab curriculum for its access to a diverse population, and in understanding the importance of discussing the types of lab assessments and the levels of acceptable performance with their colleagues. In the same survey the attendees felt they had the skills that allowed them to help their students feel supported through verbal communication equally well before and after the workshop. We believe

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that the UDL training for new faculty and TAs, as well as laboratory staff, should be provided each fall, and the authors would be happy to provide more information on facilitating a workshop on request.

CONCLUSION

Our research has led us to develop an approach to motivate all students, including those experiencing mental health issues, to experience a more beneficial laboratory experience. Stressful elements in the laboratory can be minimized by purposefully adopting supportive communication techniques, as well as by analyzing and adapting the lab curriculum such that delivery, engagement, and assessment are improved. Educating a diverse population, which includes students with mental health issues, should be an important goal in our society, and the supportive behavior of a lab instructor can have a significant positive impact on a student. Adopting this approach may facilitate more productive learning for ALL students, and we challenge you to begin the discussion in your department!

ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available on the ACS Publications website at DOI: 10.1021/acs.jchemed.6b00108.

Details for universal design for student interaction workshop (PDF, DOCX)
Workshop presentation (PDF)

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Notes

The authors declare no competing financial interest.

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REFERENCES

(1) DeKorver, B. K.; Towns, M. H. General Chemistry Students' Goals for Chemistry Laboratory Coursework. *J. Chem. Educ.* **2015**, *92* (12), 2031−2037.

(2) Galloway, K. R.; Malakpa, Z.; Bretz, S. L. Investigating Affective Experiences in the Undergraduate Chemistry Laboratory: Students' Perceptions of Control and Responsibility. *J. Chem. Educ.* **2016**, *93* (2), 227−238.

(3) Kurbanoglu, N. I.; Akim, A. The Relationship between University Students' Chemistry Laboratory Anxiety, Attitudes, and Self-Efficacy Beliefs. *Australian Journal of Teacher Education* **2010**, *35* (8), 48−59.

(4) Gruttadaro, D.; Crudo, D. *College Students Speak*. https://www.nami.org/About-NAMI/Publications-Reports/Survey-Reports/College-Students-Speak_A-Survey-Report-on-Mental-H.pdf (accessed Jul 2016).

(5) Markle, L. *Directory of Disability Services*; Ball State University, personal communication, March 15, 2015.

(6) Trice, P. *Behavioral Health Trends in the United States: Results from the 2014 National Survey on Drug Use and Health*. http://www.samhsa.gov/data/sites/default/files/NSDUH-FRR1-2014/NSDUH-FRR1-2014.htm (accessed Jul 2016).

(7) American Psychiatric Association. *The Diagnostic and Statistical Manual of Mental Health Disorders*, 5th ed.; American Psychiatric Publishing: Arlington, VA, 2013.

(8) Norman, K.; Caseau, D.; Stefanich, G. P. Teaching Students with Disabilities in Inclusive Science Classrooms. *Sci. Educ.* **1998**, *82* (2), 127−146.

(9) Accessible Campus. *Teaching Students with Mental Health Disabilities*. http://www.accessiblecampus.ca/educators/teaching-tips/mental-health-disabilities/ (accessed Jul 2016).

(10) Neely, M. B. Using Technology and Other Assistive Strategies To Aid Students with Disabilities in Performing Chemistry Lab Tasks. *J. Chem. Educ.* **2007**, *84* (10), 1697−1701.

(11) Reglinski, J. Unlocking Knowledge We Know the Students Know. *J. Chem. Educ.* **2007**, *84* (2), 271−273.

(12) Lunsford, S. K.; Bargerhuff, M. E. A Project To Make the Laboratory More Accessible to Students with Disabilities. *J. Chem. Educ.* **2006**, *83* (3), 407−409.

(13) Riviou, K.; Kouroupetroglou, G.; Oikonomidis, N. A Network of Peers and Practices for Addressing Learner Variability: UDL.net. In *Studies in Health Technology and Informatics*; Assistive Technology, IOS Press: Amsterdam, The Netherlands, 2015; Vol. *217*, pp 32−39.

(14) Bernacchio, C.; Mullen, M. Universal Design for Learning. *Psychiatric Rehabilitation Journal* **2007**, *31* (2), 167−169.

(15) Novak, J. D. *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations*, 2nd ed.; Taylor-Francis Routledge: New York, 2010.

(16) Nilson, L. B. *Teaching at Its Best: A Research-Based Resource for College Instructors*, 3rd ed.; Anker Pub. Co.: Boston, MA, 1998.

(17) Stanley, N.; Manthorpe, J. *Students' Mental Health Needs: Problems and Responses*; Jessica Kingsley Publishing: London, 2002.

(18) Glasser, W.; Glasser, C. *Choice Theory in the Classroom*; Quill: New York, 2001.

(19) Farnsworth, D. L. *Psychiatry, Education, and the Young Adult*; C.C. Thomas: Springfield, IL, 1966.

(20) Strupp, H. H. Specific vs Nonspecific Factors in Psychotherapy. *Arch. Gen. Psychiatry* **1979**, *36* (10), 1125.

(21) National Center on Universal Design for Learning. http://www.udlcenter.org/aboutudl/take_a_tour_udl (accessed Jul 2016).

(22) Disabilities, Opportunities, Internetworking, and Technology. http://www.washington.edu/doit/equal-access-universal-design-academic-department (accessed Jul 2016).

(23) Stefanich, G.; Davidson, J.; Hadzigeorgiou, Y. *Science Teaching in Inclusive Classrooms: Models and Applications*; Woolverton Printing Co.: Cedar Falls, IA, 2001.

(24) *Academic Accommodations*. http://www.cmha.ca/youreducation/accomodations.html (accessed Jul 2016).

(25) Gandolfo, A. Identifying Lurking Alligators: An Essay on the Ethical Dimensions of Faculty Development. *Innovative Higher Education* **1997**, *22* (2), 135−150.

(26) *Teaching Chemistry to Students with Disabilities: A Manual for High Schools, Colleges, and Graduate Programs*, 4th ed.; Miner, D. L., Nieman, R., Swanson, A. B., Woods, M., Eds.; American Chemical Society: Washington, DC, 2001.

(27) Pence, L. E.; Workman, H. J.; Riecke, P. Effective Laboratory Experiences for Students with Disabilities: The Role of a Student Laboratory Assistant. *J. Chem. Educ.* **2003**, *80* (3), 295−298.

(28) Dragisich, V.; Keller, V.; Zhao, M. An Intensive Training Program for Effective Teaching Assistants in Chemistry. *J. Chem. Educ.* **2016**, *93* (7), 1204−1210.

(29) Swanson, A. B.; Steere, N. V. Safety Considerations for Physically Handicapped Individuals in the Chemistry Laboratory. *J. Chem. Educ.* **1981**, *58*, 234.

(30) Steere, N. V. Identifying Multiple Causes of Laboratory Accidents and Injuries—Part 2. *J. Chem. Educ.* **1973**, *50* (5), A287.

DOI: 10.1021/acs.jchemed.6b00108
J. Chem. Educ. XXXX, XXX, XXX−XXX