

Making Lab Based Courses Inclusive

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ALLYSON MACLEAN



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Contents

Preface	1
Part I. Increasing Accessibility of Labs	
1. Introduction	5
2. Disability: Perspective and context matter.	6
3. The Unseen Challenges of Students with Disability	8
4. Additional Things to Keep in Mind	10
5. Best Practices In a Teaching Laboratory	12
6. Accommodation of Service Dogs in a Teaching Lab	16
7. Accommodation of Visually Impaired Students	19
Part II. Student Testimonials	
8. Introducing our Student Testimonials	25
9. Navigating a Teaching Lab as a Visually Impaired Student	26
10. Navigating a Teaching Lab with Epilepsy	28
11. Navigating a Teaching Lab with a Mobility Disability	30
12. Navigating a Teaching Lab with a Learning Disability	31
13. Navigating a Teaching Lab with Autism	34
Appendix	37

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Note to Educators Using this Resource

Dear friends! We encourage you to use this resource and would love to hear if you have integrated it into your curriculum. We would also love to add to this resource and value any feedback you may have. Please consider notifying Dr. Allyson MacLean (amaclea3@uOttawa.ca) if you wish to make a contribution to the text. Thank you.



Other books in the same series:

Inclusive education: simple strategies to improve equity and embrace diversity. By Alison Flynn and Jeremy Kerr: [English](#)

Remote teaching: a guide for teaching assistants. By Meredith Allen, Alisha Szozda, Jeremy Kerr, and Alison Flynn: [Français](#) | [English](#)

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About eCampusOntario

[eCampusOntario](#) is a not-for-profit corporation funded by the Government of Ontario. It serves as a centre of excellence in online and technology-enabled learning for all publicly funded colleges and universities in Ontario and has embarked on a bold mission to widen access to post-secondary education and training in Ontario. This textbook is part of eCampusOntario's [Open Library](#), which provides free learning resources in a wide range of subject areas. These open textbooks can be assigned by instructors for their classes and can be downloaded by learners to electronic devices or printed. These free and open educational resources are customizable to meet a wide range of learning needs, and we invite instructors to review and adopt the resources for use in their courses.

PART I

INCREASING ACCESSIBILITY OF LABS

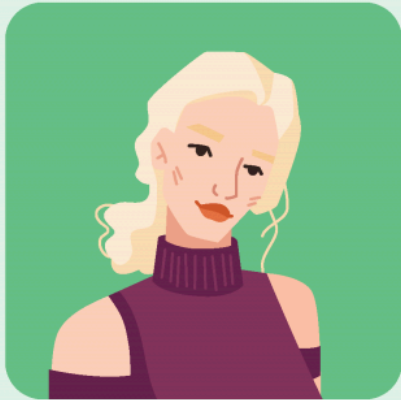
1. Introduction



This resource is meant to provide general guidance on enhancing the accessibility of lab-based courses, with a particular focus on supporting the learning of students with physical disabilities. Individuals with disabilities are under-represented within scientific disciplines, and students with physical disabilities may even be discouraged from taking science-based courses in part due to concerns about the relatively inaccessible nature of scientific laboratories. It is worth emphasizing that while students with disabilities represent a small minority of the overall student population, the implementation of inclusive teaching practices has the potential to benefit learners of all abilities. Uniquely, teaching laboratories are learning environments in which poorly designed spaces and unsafe practices not only have the potential to adversely impact accessibility and learning but, at worst, may represent danger to a student and others in the class.

These guidelines have been developed in consultation with the [University of Ottawa's Centre for Students with Disability](#) and following interviews with Faculty of Science undergraduate students with various disabilities about their experiences in our labs. It is important to emphasize that all individuals are unique, as are all disabilities. While this resource offers general advice designed to enhance accessibility in teaching laboratories, care should always be taken to consult directly with individuals about their disabilities, as well as learning support specialists, and medical professionals as deemed appropriate.

2. Disability: Perspective and context matter.



“

Do not assume
my abilities.

Océanne Comtois

Océanne Comtois, graduate of Life Sciences program, and legally blind.

Key Takeaways

- Disabilities fall within a broad spectrum and the learning environment must be taken into consideration when assessing the impact of a disability on student learning.
- Teaching laboratories are a unique learning environment that may present disabled students with unusual challenges.
- When determining how best to support in lab learning, the importance of consulting with a student directly about her/his/their (dis)abilities must be a priority.



A disability is generally defined as any long-term condition of the mind or body that limits a person's ability to interact with other people and/or the environment. An important nuance to this definition is that each disability falls within a broad spectrum that will include individuals who may not be aware of their impairment (unknown or undiagnosed disabilities) and individuals who have a disability that is not evident to a casual observer (so-called hidden disabilities). Depending upon one's point of view, disabilities may also be considered to simply represent one end of a spectrum that encompasses the abilities of all individuals. For example, a student with a learning disability may be considered to fall within a continuum of learning abilities inherent within a student population, rather than representing part of a distinct group of individuals that is separate from "normal" learners. An individual's own perspective is also key to determining

whether a person identifies as having a disability or not. Members of the Deaf (uppercase 'D') community comprise individuals who are typically born without hearing, are fluent in Sign language as their first language, and have a shared culture; members of this community may hold a viewpoint that their inability to hear is not a disability but rather that they differ in their primary means of communication. Individuals who identify as deaf (lowercase 'd') are more likely to have lost their ability to hear after learning language as a young child, and are also more likely to identify their loss as a disability.

Some disabilities will severely limit an individual's ability to learn and/or interact with(in) all learning environments. In other cases, a given disability may have little to no impact on learning in one instance yet exert a measurable impact on learning in another environment. In other words: context matters and should be considered when assessing how learning may be better supported. This is particularly relevant to 'in lab' learning because teaching laboratories are a unique learning environment that may present students with unusual challenges. A student with low vision may excel academically in a classroom environment with the support of assistive technologies, yet it is unlikely that analogous assistive technologies will be available and appropriate to support learning in a teaching laboratory. Conversely, a student with autism spectrum disorder may be at a disadvantage when required to collaborate closely with other students in a group project, but may have no difficulty navigating tasks assigned within a chemistry lab. Thus, a particular student may be considered to have a disability that requires accommodation in one context (for example, in a laboratory setting) and not another (for example, a classroom). This complexity is in fact an asset because it means that learning can often be enhanced by proactively implementing a strategy of diversifying the methods of instruction, task assignment, and assessments of learning (for more details in how this may be accomplished, refer to Resource 4).

When determining how best to support in lab learning, the importance of consulting with a student directly about their (dis)abilities should be a priority. Too often instructors risk the error of assuming limitations based upon their general understanding of the nature of a disability, incorrectly concluding that a disabled student may be unable to complete a course objective that is in fact within their reach. A student who is legally blind, for example, may still be able to discern colours and shapes, and may use these as visual guides to accomplish tasks and participate in lab activities. Conversely, instructors may err in assuming abilities that are beyond the scope of an individual student, unwittingly placing expectations on the learner that are unreasonable or unrealistic for that individual to attain. A student with a disability that manifests in chronic joint pain or joint instability may be perceived to move about 'normally' in lab initially but may be unable to stand pain-free without support for the 2-3 hours that typify most lab courses.

3. The Unseen Challenges of Students with Disability

Although a laboratory setting may present unusual challenges to students who have a disability, it is very likely these students will have already overcome numerous obstacles prior to setting foot in a teaching lab. While by no means a complete list, we highlight herein a few of the difficulties students with disability may face while pursuing their education, summarizing many hours of interviews with undergraduate students about their experiences. Keeping these challenges in mind can be helpful in identifying ways to best support our students achieve their goals.

Accessing accommodations takes time. An issue educators should be aware of (particularly at the start of an academic year) is that it may take several weeks for applications for academic accommodation to be processed. Please keep this in mind if you are approached by a student(s) requiring accommodation that has yet to be formally documented by the institute. Please also keep in mind that some students (particularly with cognitive and/or learning disabilities) may be grappling with newly diagnosed conditions, possibly unmasked by the challenges of living outside of a supportive family home for the first time. These students may have a more difficult time ascertaining what accommodations would be most beneficial to their learning, and are likely to be less than familiar with the process of seeking accommodation.

Arriving to class “on time” may be difficult. University campuses may be quite large, and scheduling of classes does not always take into account how difficult it may be for students to get from class A to B on time. A student with impaired mobility sent me her class schedule to review, and I was shocked to see her schedule required a 1.1km walk from one side of campus to another within 10 minutes, with a Google estimate of an able bodied person requiring 14 min to cover this distance. After the second class, she was then required to walk another 1.2km (Google estimate, 15 minutes for an able bodied person) to return to a building located adjacent to the first class. Despite her best efforts, she was frequently late to both classes, and unnecessarily exhausted by the ordeal. If you observe students struggling to arrive on time, consider asking for a change in venue. At the very least, ensure you **NEVER go over the allotted lecture time**, as this will make it difficult for all students to reach their next class on time, and will disproportionately disadvantage students with physical disabilities.

In many countries, **mobility on campus is difficult in winter** due to ice and snow. For some students with disability, this is such an issue that they avoid registering for classes that require attendance on campus in winter months. The advent of online/hybrid lectures during the COVID-19 pandemic offered many disabled students unprecedented access to their classes, regardless of weather. **Consider recording your lectures on a platform such as Zoom if possible**, and providing the link to the class.

Accurate captioning and scientific terminology. If you have ever switched on the ‘Live transcript’ feature in Zoom whilst giving a lecture, you’ll quickly realize that these systems do not marry well with scientific terminology. ‘Apoptosis’ becomes ‘A pop Josias’ and ‘Xanthomonas’ is reformulated to “exam the bonus”. Judicious inclusion of terms on your slides during a lecture will help to clarify meaning (for all students), and ideally transcripts would be edited to ensure words are correctly transcribed. If possible, providing students with a copy of your presentation *before* the lecture may also help.

Expense. Having a disability can be very expensive, with government subsidies and support from charitable organizations only partially offsetting these costs. For this reason, many students with disability may be required to work part-time to subsidize their cost of living, which may reduce time available for study. Most people can readily appreciate that the purchase of specialized equipment such as a wheelchair may cost thousands of dollars, but you are likely unaware that service dogs (for example) may cost as much as a small car depending upon their training. Other less obvious expenses include the acquisition of medical documentation that may be required to access accommodations, and/or doctor’s notes that may be requested when a student

is unable attend a lab or complete an assignment / evaluation (such as a midterm or final exam) 'on time'. Medication and treatments are not always fully covered or reimbursed by insurance policies, further stretching a limited budget. If an individual has a mobility impairment, there may be additional costs associated with transportation, and individuals with disability are likely be disadvantaged with respect to finding affordable, decent housing that accommodates their needs yet is located near campus. As a consequence, many students opt to live on campus, yet that is often more expensive than off campus housing.

4. Additional Things to Keep in Mind

In the course of preparing this resource, I had the privilege to interview undergraduate and graduate students with a range of disabilities about their experiences navigating teaching and research labs. Based upon these interviews, I offer the following advice for educators to keep in mind when interacting with our students.



Disclosing a disability is a choice. Students have a right to privacy, and educators do not have a right to ask questions about personal health.

Do not assume a student's abilities based upon *your* understanding of their disability. The most important resource to consult in determining how best to support student learning is the student his/her/their/self.

The two points above give testimony to the undeniable reality that **it may be difficult to simultaneously acquire the information necessary to support student learning in lab whilst respecting an individual's right to privacy.** This is where academic supports such as Student Accessibility Services have a responsibility to guide educators. However, the unusual nature of 'in lab' learning may nonetheless require a student and educator to collaborate together to best ensure accommodations are suitable and practical.

In many countries such as Canada, **you have a legal obligation to accommodate.**

Be aware that some students may be awaiting diagnoses. This is particularly true of cognitive and/or learning disabilities that may have been unmasked in students who are living outside of the supportive family home for the first time.

Having a disability can mean different things on different days. Depending upon the nature of a given disability, a student may be 'fine' one day, and too ill to attend class the next day. Certain conditions (examples include multiple sclerosis, epilepsy, rheumatoid arthritis) may result in intermittent disability. The dynamic nature of these disabilities presents it's own challenges, namely:

Having a disability may make it difficult impossible to plan ahead. If a student with disability requests an extension to an assignment, a reasonable question you may have is 'How long do you need?'. Sometimes, a reasonable answer actually is 'I don't know'.

Having a disability can be exhausting. Any number of factors can contribute towards fatigue, including the additional time required to complete study tasks, physical and emotional stresses specific to the disability in

question, part-time employment to subsidize costs, even paperwork and documentation of a disability may drain our students of valuable energy needed for study.

Avoid 'surprise' assessments. This particularly applies to that old favourite of Science: the pre-lab quiz. Students with disabilities such as ADHD often fare poorly in quick, short, quizzes administered in a distracting lab environment, yielding grades that are not at all reflective of their preparedness or understanding of material. In lieu of an on-the-spot pre-lab, consider offering an online quiz that students may complete in advance at home, or in an environment of their choice.

Scientific laboratories can be scary. And potentially dangerous. For those of us who have made a career in a lab setting, it may be easy to forget how unusual and even scary these environments can be to any new student. Potentially harmful chemicals stored in breakable glassware, Bunsen burners as a source of open flame, scalpels and razor blades, glass equipment, and a crowd of excited and distracted peers. The opportunities for injury are many in a typical teaching lab, and normal levels of apprehension can be magnified in individuals with disabilities that reduce movement or perception.



5. Best Practices In a Teaching Laboratory

Key Takeaways

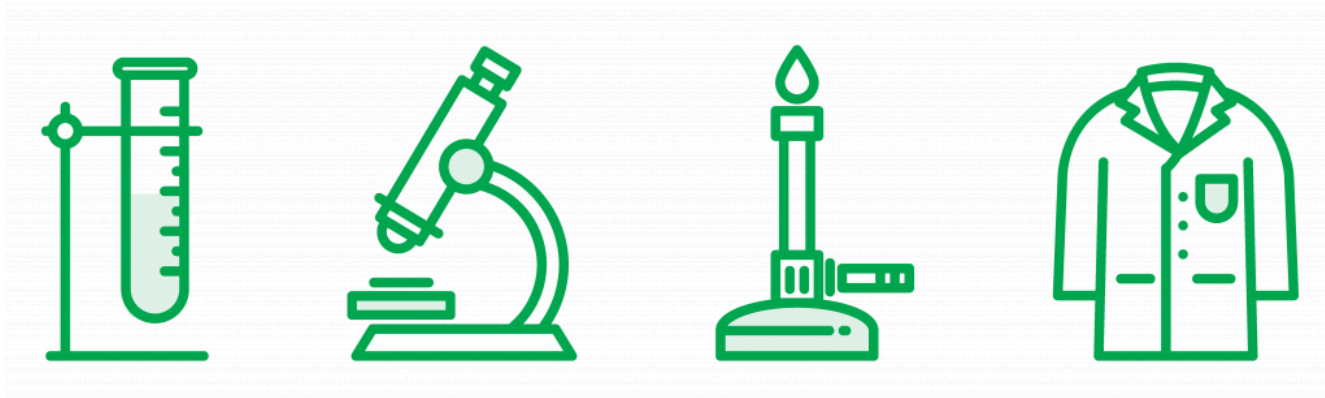
- Firsthand experience is invaluable in identifying potential barriers and hazards to safety. Students with physical disability may benefit from visiting the teaching lab *prior* to the first day of class.
- Assuming a teaching lab is accessible because it is 'supposed to be' is not sufficient to ensure accessibility.
- Keep it clean! A clear, well organized lab environment is key to ensuring accessibility and safety of all students.
- Avoid in lab quizzes as a means of assessing student preparedness and/or understanding.
- Many pieces of commonly used lab equipment can be readily modified to increase accessibility.

Orienting towards success

Many students with physical disabilities will benefit from being allowed access to the building and teaching laboratories *prior* to the first day of class, and this should be encouraged by offering students a guided tour of these locales by the course instructor, a teaching assistant, or a lab coordinator. This exercise will provide students an opportunity to map out their learning environment in the absence of distraction and will allow them to directly assess the accessibility of the room and building firsthand. Ideally, should any issues with accessibility be identified, the instructor will also have sufficient time to address these before the course commences. This activity will also allow students the chance to discuss any particular concerns they may have with instructors in the absence of their peers and offers an excellent opportunity to establish a positive connection between the student and instructor.

All physical disabilities fall within a spectrum, and individual students may vary greatly with respect to their capacity to navigate an in-lab environment. Simply assuming a room and building to be accessible because it is "supposed to be" or has been identified as being accessible to individuals in a wheelchair (for example) is not sufficient to ensure accessibility for all individuals. Making these assumptions creates the real risk of a student with a physical disability being unable to readily access their teaching lab on time at the start of the course, putting your student at a disadvantage from day one, and creating unnecessary stress for all involved. It is equally important to consider that in many instances teaching laboratories will vary in design, and in how they are set up for a given course. For these reasons, allowing students advanced access to their assigned teaching lab (i.e., not just an adjacent lab that is similar) is the best way of ensuring your student's success.

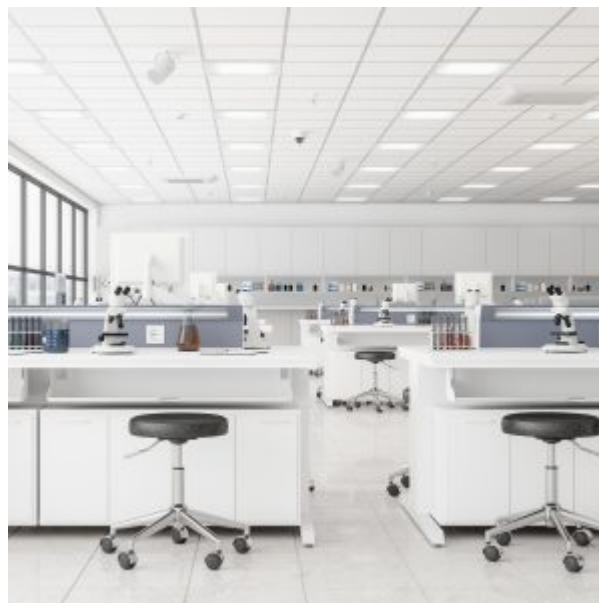
Starting off on the right foot



As a rule, best practice dictates that an instructor discuss accessibility and safety with the class at the beginning of the first “in lab” activity. Initiating this dialogue informs students that you care about their safety and wellbeing and encourages individuals with concerns to discuss these with you. Always keep in mind that a student may not wish to disclose their disability, nor do you have a right to this ask invasive questions about the nature of their disability or health. Moreover, a student may not necessarily be aware that they have a disability (particularly relevant to cognitive and learning disabilities), or may not realize that their disability has the potential to impact learning in this unique environment (particularly true if an individual has not been in a laboratory setting before). For example, individuals with Sensory Processing Disorder or autism spectrum disorder may be adversely affected by the unusual smells or sounds that can occur in teaching laboratories, especially if these occur unexpectedly from the student’s point of view. This is also relevant to individuals struggling with Post-traumatic stress disorder. For this reason, it is recommended that an instructor give a heads-up to all students at the start of a lab when an experiment is likely to give rise to loud noises and/or unusual smells. This is also important in instances where service dogs may be exposed to unfamiliar sounds/smells, and may be adversely affected. For more details on how to safely accommodate service dogs, please refer to the section below.

Keep it clean

Many of the “best practices” that have been commonly adopted to promote student safety in teaching labs are key towards ensuring the wellbeing of disabled students in these environments. Keeping aisles clear of obstructing materials (such as student backpacks, coats, and lab equipment) is of paramount importance in classes that include individuals with low vision and/or impaired mobility disabilities. Ideally, all students should be provided with lockers outside the classroom to store their belongings, apart for items necessary to the lab (such as pens/pencils, lab manual). An important variation to this rule is that some students may have conditions that require immediate access to medications or medical devices (for example). In these instances, best practice may entail permitting such a student to keep these possessions stored within a small bag, with the understanding that this object should not be placed upon the floor or lab bench



but must be kept upon their person at all times. Similarly, students with conditions such as ADHD and autism spectrum disorder may benefit from having access to small sensory “stim” or “fidget” toys that aid in promoting focus and/or self-soothing in the lab. Small items such as spinner and spiky sensory rings are ideal for an in-lab environment, as they are often worn as jewelry upon a person’s body, however these may present difficulties if worn on hands when gloves are required. Chewable jewelry, which is less common in adults, should be discouraged in many instances to avoid contaminating the item with chemicals or biological hazards.

Avoid that old stand-by: the pre-lab quiz

When I was an undergraduate student, many labs would start with a pre-lab quiz that was designed to encourage student preparedness, and assess our understanding of the lab, and pre-lab quizzes still represent a commonly used tool in lab-based courses even today. Nevertheless, short quizzes that are tightly timed are poor evaluators of students with many commonly occurring learning disabilities, including ADHD. Such students struggle to perform well in a testing environment rife with distractions, and yet the short duration of such quizzes effectively precludes testing in an alternative centre, as would be allowed for a formal exam. Although it may be tempting to dismiss these concerns if the quizzes represent only a small percentage of a final grade, keep in mind that poor performance on a quiz (even one that is not worth much) is stressful and discouraging, and will likely undermine a student’s confidence at the very beginning of a lab. An easy to implement alternative is to offer the same quiz in an online format, allowing students to complete the assessment in a quieter environment of their choosing.

Specialized Lab Equipment & an Extra Set of Hands

Many pieces of commonly used lab equipment may be easily modified to accommodate various types of disability, with examples including:

1. Addition of enlarged, high contrast markings to help users with impaired vision. Examples: rulers, thermometers, syringes.
2. Equipment that 'speaks' to users. Examples: calculators, scales, thermometers.
3. Modified pipette-filling devices, for users who may not be able to grasp a traditional pipette.
4. For some visually impaired students, lab activities may be supported through the use of colour-coding schemes, in which coloured pieces of tape may be used to aid in identification of chemicals, for example.

A great resource that provides more information about specialized lab equipment, and manufacturers, is the [DO-IT Centre](#) (Disabilities, Opportunities, Internetworking, and Technology).

In cases where an individual may not have reliable use of his/her/their hands, a work around may be the recruitment of a TA to offer an extra set of hands, following instructions provided by the student. This partnering may also work well to support students with impaired vision. While it may seem like an easy solution to partner a student with a disability with an able-bodied classmate, keep in mind that this may cause unnecessary stress to both students: the first student may feel concern about slowing down or inconveniencing a peer, whereas the 'helper' student may feel pressured to take on too much.

6. Accommodation of Service Dogs in a Teaching Lab



By Dominique Daniels

Introduction

Some disabled students require the use of a service dog to safely perform daily tasks including school and lab work. A service dog is a dog that has been trained to aid or guide a person with a disability (Ontario Service Dogs Act, 2016). To become certified, service dogs undergo rigorous training for both their tasks as service dogs and for appropriate behaviour in public settings. There are many types of service dogs including guide dogs, mobility assistance dogs, diabetic alert dogs, seizure alert and response dogs, and many more. Service dogs are identifiable by either a vest or harness worn by the dog, or through medical documentation carried by the handler (AODA, 2005). In Ontario, service dogs are to be treated the same way as any other accessibility aid and must be allowed access to public places and school facilities (Ontario Service Dogs Act, 2016).

Service Dog Etiquette

Service dogs have important jobs and must be given the space to focus on their tasks. In a lab setting, this focus is even more important as distracting a service dog can have serious consequences for the safety of the student and the dog.

The following behaviours are very distracting to service dogs and should be avoided unless given specific permission by the handler:

- Petting or touching the service dog
- Speaking to the service dog

- Whistling, waving, or calling to get the attention of the service dog
- Feeding the service dog

When speaking to someone with a service dog, always remember to address the person, not the dog. Be respectful of the student's private medical information and only ask questions about the function of the service dog when the information is needed for safety or accessibility reasons. To protect the privacy and safety of the student, never take or post pictures or videos of a service dog on social media without specific informed consent from the student.

Safety

Learning laboratory health and safety practices are an important component of undergraduate lab courses. Lab courses are an excellent opportunity for students with service dogs to learn appropriate lab safety measures for their dog prior to pursuing research lab work. Safety decisions should be made in collaboration with the student as each service dog team will have different needs and safety concerns based on the nature of the dog's tasks. However, any service dog will need to wear the appropriate personal protective equipment (PPE) and have a safe place to sit or lay down during the lab sessions.

PPE

Service dogs require protection from the same hazards as humans, therefore they also require the same level of PPE as humans. Depending on the activities and hazards of the lab, service dogs should wear lab coats, goggles, and boots. Activities with a high risk of spill should be performed away from the dog, and a non-absorbent mat may be needed for the dog to sit on to prevent spills from reaching their spot on the floor. Keep in mind that many breeds of dog can be service dogs and the specific recommendations below may not be the best choice for every dog. As such, the student should be consulted before any PPE is purchased to ensure it will fit the service dog.

Service dog PPE

Service dogs can wear the same lab coats as humans, which often can be purchased at a [Campus Bookstore](#) or [Science Store](#) for roughly \$30.00 CDN. To ensure comfort and avoid restriction of movement, the size of the lab coat should be chosen based on the width of the dog's shoulders. To put a lab coat on a dog; the front legs go through the arms of the coat and the back of the coat drapes over the back of the dog. Excess material can be tucked into the bottom of the service dog vest to avoid dragging behind or tripping. Note that there are not currently any legitimate lab coats made for dogs. **The “dog lab coats” available online are meant for use as a costume, not as protective equipment.** Only purchase a lab coat from a legitimate PPE supplier.

It can be difficult to find appropriate eye protection for dogs. The most common choice for working dogs is [Rex Specs](#) as they have a tight seal around the eye area to protect from splashes, and the polycarbonate lenses are shatter proof and have passed the ANSI z87.1-2010 Impact Resistance Test. The Working Dog model of Rex Specs can be purchased online at [rexspecs.com](#) for roughly \$80.00 USD.

There are many options for foot protection for service dogs. An easily available option is [Pawz boots](#) which are available in many sizes and can be purchased at most pet stores for roughly \$20.00 CDN for a package of 12 boots. These boots are disposable but can be worn multiple times before being worn out. These boots come

in packages of 12 because they do not last long, but this may be advantageous for lab work as it means they can be thrown away if they come into contact with a spill. Some dogs find the rubber texture of the boots uncomfortable, but baby socks may be worn under them for extra comfort. There are also cloth boot options for dogs that are reusable, but these may be too warm for indoor use and costly if they need to be thrown away after exposure to a spill.

If large spills are a risk in the lab, then a non-absorbent mat should be used as a safe surface for the dog to sit or lie on. Many non-absorbent mats are available at pet stores and can be cut to the appropriate size for the dog and area. One option is the Cushioned Crate Mat made by Mid West, which can be purchased at most pet stores for roughly \$50.00 CDN. This mat is water resistant and easy to clean and disinfect.

Other Safety Considerations

Service dogs require a safe place to sit or lay down while students perform experiments. Students with service dogs should be assigned a bench near a safe area where the dog will not be tripped over or stepped on. This could be a bench near the perimeter of the room or one that is next to an unoccupied bench. Some labs have spots under the lab bench that the dog can sit in, depending on their size. The needs of each service dog team are different, and the student should always be consulted when choosing the safest bench for them.

Dogs have a stronger sense of smell than humans and this is often what allows service dogs to perform jobs such as seizure detection. As such, service dogs can be more sensitive to strong odours in the lab. When service dogs are present, extra caution should be taken to perform experiments with strong odours in a fume hood and away from the service dog. Additionally, dogs can also be more sensitive to noise than humans. To protect their hearing, service dogs should be kept away from very loud equipment (e.g., sonicators), but when moderately loud noise is present, a student may choose to use cotton balls as ear plugs for their service dog.

7. Accommodation of Visually Impaired Students



By Océanne Comtois

Key Takeaways

- Visually impaired students are eager to participate in lab activities.
- The lab is such a unique environment that special accommodations will be required and flexibility is extremely important.
- When having discussions about how to accommodate a student, instructors should prepare in advance a list of activities that will be required in the course to guide the

discussion.

- Instructors should consider letting visually impaired students partner up in groups of three rather than the traditional group of two.
- Alternatively, consider allowing visually impaired students to bring an assistant into the lab to help execute tasks they may not be able to complete on their own.

Background

These considerations were drafted after consulting with 3 other visually impaired students, including myself. These students had all studied or are currently studying biological science programs at various academic institutions. Individual meetings were held where students were asked to answer the questions outlined below and responses have been summarized below.

“What do you wish your instructor knew when you started?”

Visually impaired students want to participate in lab activities and are eager to do so, they just need to know how they can participate and be able to work around certain limitations. Please always keep in mind that visually impaired students may be just as frustrated and anxious about navigating a teaching lab as you (the instructor or TA) might be. Unfortunately, there exist very few resources to guide visually impaired individuals within a lab environment. Although the list of approved accommodations should extend to include laboratory courses, the lab is such a unique environment that special accommodations will be required beyond those necessary in a traditional classroom or lecture hall, and it's difficult to determine in advance what will be needed when learning new techniques. Flexibility is extremely important.

The instructor's attitude towards a student and their disability will impact a student's attitude in the course, and will determine whether the student feels comfortable discussing accommodations with the instructor. A welcoming environment makes a huge difference. Always keeps in mind that visually impaired students are aware of their limitations and want to feel encouraged and welcomed in the lab.

“What can instructors who teach lab courses do to better support students moving forward?”

- When students reach out with an accommodation letter or disclose their disability, respond to them and offer to discuss how you can accommodate them in the lab.
- When having discussions about how to accommodate a student, instructors should prepare a list of activities that will be required in the course. This list should comprise of technical skills that will be required, equipment that will be used, and how students will be evaluated.
- Instructors could be more open to being flexible with their assignments and marking schemes. If a student has approached the instructor about their limitations, these limitations should be taken into consideration when evaluating and grading the student.
- Instructors should realize that not every student has the same accommodations and what might have worked for one student may not work for another student.
- Instructors could let visually impaired students partner up in groups of three rather than the traditional group of two. This can remove pressure from the student and allow them to contribute while allowing

their partners to take on the tasks the student is uncomfortable performing.

- Instructors can post their educational material or privately send it to the student ahead of time.
- Instructors can make sure that they can distribute an accessible version of their documents upon request.
- When giving a demonstration, allow visually impaired students to get closer to the demonstration, brief them on the demonstration after they've presented to the group, or give them a set of clear written instructions.
- Instructors should not disclose the students' visual impairment to a group and should refrain from publicly singling out the student.

“What can your faculty administration do, or instructors advocate for the administration to do to better support students with disabilities in the lab?”

- Creating a teacher's assistant training program to help TAs (who arguably have a more direct relationship with the students in the lab) to better understand how to help students with disabilities in the lab and how to interact with students with disabilities.
- Allowing students to bring an assistant in the lab to help execute tasks they may not be able to complete on their own. This assistant would follow directions given by the student and would have lab experience to be able to perform the tasks according to the directions given by the visually impaired student.
- Implementing principles of universal design when creating or updating laboratory spaces. Universal design benefits everyone.
- Include or update an accessibility statement in the syllabus to encourage students to reach out to the disability services office and encourage them to share their accommodations with their professors.
- Find ways to encourage and incentivize students with disabilities to pursue extracurricular research opportunities.

PART II
STUDENT TESTIMONIALS

8. Introducing our Student Testimonials



In this section, we invite you to read testimonies shared by University of Ottawa undergraduate students enrolled in the Faculty of Science. These testimonies offer insight into the challenges students faced while pursuing their studies, and highlight the ways in which educators helped students to achieve their academic goals.

These testimonies were written by the students themselves, with all students agreeing to share their names in this publication.

9. Navigating a Teaching Lab as a Visually Impaired Student



By Océanne Comtois



I’m a firm believer that a scientist is not defined by their abilities, but rather their passion for science and research.

Being visually impaired in a lab setting can be extremely challenging at times. While there are many types of visual impairments, my visual impairment impacts my depth perception, my ability to see objects from far, and small objects. Additionally, it is extremely difficult for my eyes to focus on what I’m looking at, which leads to eye fatigue and a lack of coordination skills. Following visual demonstrations, working with small concentrations, activities that require precision, or noticing minor details can be difficult for me, and unfortunately, can lead to negative experiences in the lab or even affect my academic performance in the course. I was always very eager to try new techniques and skills but I often felt like my vision held me and my classmates behind which made me feel nervous and uncomfortable taking lab courses.

In addition to the physical barriers, the laboratory classroom presented many other social barriers that were difficult to navigate. I've had difficult situations with professors and teaching assistants where I was purposefully excluded from activities, private information about my disability was disclosed publicly to my classmates, and hurtful and offensive statements or false assumptions were made about my abilities. Although these instances were resolved appropriately, it was arguably these experiences that have impacted me the most and have made me feel apprehensive about taking more laboratory courses as well as continuing my studies and career in science.

Despite these few experiences I've had a generally positive experience with my professors who were always eager to help accommodate and make me feel welcome in their classroom. By maintaining an open and honest

“By maintaining an open and honest line of communication, we were able to find different ways to evaluate my performance in the practical components of the lab”

line of communication, we were able to find different ways to evaluate my performance in the practical components of the lab such as setting up similar yet different evaluation criteria taking into consideration my limitations, allowing someone else to do manipulations in the lab while I give oral instructions, ensuring that all instructions are given before the class and that demonstrations are written and described in detail, letting me tour the lab and get familiar with my environment at the very beginning of the semester, and clearly communicating the objectives of the course so that I can troubleshoot any possible problems that may occur throughout the semester.

I'm a firm believer that a scientist is not defined by their abilities, but rather their passion for science and research, which is why I think it is crucial that we find ways to make science inclusive to people with disabilities not only through accommodations in the classroom but by redefining the way we perceive disability.



“I was always very eager to try new techniques and skills but I often felt like my vision held me and my classmates behind which made me feel nervous and uncomfortable taking lab courses.”

10. Navigating a Teaching Lab with Epilepsy



“Creating accessibility guidance and listening to the experiences of disabled students can go a long way for creating better lab course experiences.”

By Dominique Daniels

Throughout my undergrad, lab courses were by far my favourite as I was always excited for the chance to learn and practice new lab skills. But lab courses also came with many challenges related to my disability. All my classmates and most professors, lab coordinators and TAs were supportive and willing to make the necessary accommodations. However, the first few years of my degree were made very difficult by the fact that the Faculty of Science was unprepared and ill-equipped for a student with a service dog. This unpreparedness resulted in little to

no guidance for protecting my service dog in the lab, leaving me to come up with safety procedures and make PPE choices on my own. This was a very challenging task for a first-year student who had never been in a lab before.



Those who saw me as a novelty would address my service dog instead of me, interacted with my service dog in distracting ways, and even took pictures of my service dog without my permission.

The unpreparedness also affected the way I was treated by several members of the faculty. It seemed like many people in the faculty saw a student with a service dog as either an inconvenience or a novelty. Those who saw me as an inconvenience made it clear that they didn't agree with allowing a service dog to be in a lab, and I was even told by someone in a leadership role in the faculty that when I was on CO-OP terms it “made [their] life easier” because I wasn't in any lab courses. These comments were discouraging, and I began to think there

wasn't a place for me in science and doubted my abilities to pursue a career in research. Those who saw me as a novelty would address my service dog instead of me, interacted with my service dog in distracting ways, and even took pictures of my service dog without my permission. Once a TA took and posted a photo of my service dog in PPE to Reddit without my permission or knowledge. This post became very popular and resulted in me receiving death threats and messages telling me to "get out of science". Now I see this incident as a misguided attempt to post a cute picture of a dog in PPE, but at the time I was terrified and saddened by the way people viewed disabled students.

With more awareness and training for staff, many of these experiences could be avoided for disabled students in the future. Creating accessibility guidance and listening to the experiences of disabled students can go a long way for creating better lab course experiences. I'm thrilled to see the new accessibility efforts being made by the Faculty of Science and my hope is that the next cohort of disabled students won't feel the way I did during my undergrad.

11. Navigating a Teaching Lab with a Mobility Disability



By Victoria Ogden



Having choice makes all the difference. There is rarely ever a one-size-fits-all solution that doesn't put someone at a disadvantage.

I started university a few years ago and remember a big shift from my high school teachers being invested in my learning to feeling left to fend for myself. As a young adult, I appreciated the freedom, but over time, I could feel the lack of support negatively impacting my learning. It wasn't until the end of my third year that I was diagnosed with mobility disabilities and chronic pain. I eventually found the support of the disability office who have helped find

some accommodations for me, but I continue to face challenges as a disabled chemistry student.

There have been times where I've felt that science isn't for people like me because of professors who have articulated this both directly and indirectly through going to great lengths to not accommodate me. I try to lean into the guidance of professors who instead want to become better teachers to everyone. The difference in attitude can be striking. I hope that an emphasis in teaching continues to grow in value alongside research in appointment decisions. This attitude does permeate down into what students with disabilities experience.

One of my most challenging experiences was when I missed an organic chemistry lab at the start of the semester. The lab coordinator couldn't arrange for a make-up lab session and wouldn't agree to reduce some of the content, and I was told to work twice as hard in the next lab session. The lab was six hours long and I did not stop for food, water, or a break even once. The experience was incredibly stressful, caused an illness flare up, and I overall regret not standing up for my health more. I ended up having to drop the lab course.

On the other hand, I really appreciate the professors that go the extra mile and brainstorm different solutions with me when I am ill and miss a midterm or an assignment. Sometimes this means make-up assignments, shifting the weights, or assessing through different (but equivalent) formats. Having choice makes all the difference. There is rarely ever a one-size-fits-all solution that doesn't put someone at a disadvantage.

12. Navigating a Teaching Lab with a Learning Disability



By Allison O'Rourke

I was diagnosed with my learning disabilities at a later age than many would expect; I was 19 and halfway through my first year of university. When I was a child, I struggled a lot with subjects like math and reading, but because nobody really talked about the variety of ways in which learning and developmental disabilities present across the genders, I was just told to try harder. Throughout grade school, I simply overcompensated for my disabilities in order to succeed. The obvious problem with this strategy being that by the time I got to university, I was not only exhausted from expending all of this extra effort to focus and compete academically with my peers, but I was also frustrated that I seemed to be working three or four times as hard as my friends and still not seeing results in terms of my grades.

With that being said, I will admit that having ADHD does give me abilities that can be useful in certain circumstances. I am an ace at multi-tasking, so being in the lab is second nature for me, where you have to keep track of 5 different parts of your experiment at once, which I can do without breaking a sweat and while having a conversation with everyone around me. But the second I have to write pre or in-lab quizzes at the lab bench, everything changes.

I remember in my first year biology labs, I failed every single one of my pre-lab quizzes, not only because the questions were just quickly put on the screen in front of us, but also because we were made to quickly do unit conversions with no calculator. As you can imagine, that did not exactly go well for me. My TA came up to me at one point and said “Why do you keep getting every question wrong, I explained how to do the conversions right before the quiz”, and at that point I couldn’t articulate why I could barely remember how many zeroes are in a thousand, let alone how many nm are in a cm, in order to explain why I was failing. It was the same scenario for other lab quizzes I wrote on the spot asking me about specific details in the lab procedure, like how many mL of cyanide we’re putting in the reaction mixture, because I cannot memorize things like that. But I show up every lab session being able to explain the big picture of the procedure and why we perform each step the way we do, and I prove that by usually getting results and being one of the first out the door at the end of the session.



When you give students with learning accommodations the ability to utilize said accommodations in all assessments, you give us the opportunity to perform around the level of our peers.

I've begun to think over the course of my time in university that pre-lab quizzes don't accurately reflect students' knowledge and understanding of lab procedures and course subject matter. Throughout the pandemic, we have proven that we as educators and learners are incredibly capable of adapting and using the internet and virtual platforms in order to assess students – we should consider taking of these principles back into the classroom with us. When you give students with learning accommodations the ability to utilize said accommodations in all assessments, you give us the opportunity to perform around the level of our peers, without implicitly or unintentionally othering us as soon as we walk through the doors of the lab.

“Just because you give us the same tools and the same training, doesn't necessarily mean we will be able to use the tools with the same level of proficiency.”

The second situation I wanted to briefly highlight is that of professors only going over assessments in a group setting instead of in one-on-one meetings with students. The logic here being that everybody has the chance to hear what the educator has to say, and nobody gets an unfair advantage. On the surface, I understand the reasoning behind this, however in

practice it is more of an “equality” approach rather than an “equity” one. Just because you give us the same tools and the same training, doesn't necessarily mean we will be able to use the tools with the same level of proficiency.

I personally have found one-on-one interactions with my professors to be far more rewarding than group discussions, as I have more freedom to express what I need, or how I need certain concepts explained to me in order for me to succeed. This way I am also not left with the guilt or the perception that my needs as a student are wasting time or taking away from the learning experiences of my peers. While I say that I'm okay going into a group assignment correction with my “hi I'm disabled please don't judge me” disclaimer, there is unfortunately a certain level of guilt and shame that is accompanied by it. And by including my personal work in group discussions, unfortunately this increases the potential for creating an uninviting or hostile environment between me, my peers, and my educator.



By being willing to engage with students who are open to discussing accessibility in their classrooms, you allow us to advocate for ourselves without shutting us down.

So, where does all of this leave us? What can we feasibly do to make academia a more welcoming and equitable environment for neurodivergent students? It starts with listening. By being willing to engage with students who are open to discussing accessibility in their classrooms, you allow us to advocate for ourselves without shutting us down. As I mentioned, the guilt and shame of having a disability keeps many of us, myself included a lot of the time, from reaching our high levels of potential. Going into

these conversations respecting each other's experiences as educators and as neurodivergent students, we will hopefully be able to not only foster a learning environment where neurodivergent students are able to compete equally with their peers, but are also welcome to do so.

13. Navigating a Teaching Lab with Autism



By Sophie Tomlin

“One of the most important things you can do for students is to be willing to learn and collaborate. School and learning typically caters to one way of learning, so a little bit can go a long way.”

Over my years as a student, I've been fortunate to have had some wonderful, and understanding teachers. I also did fairly well in school, as the environment lent itself to a lot of structure, which was essential to my well-being. As someone who struggles with very sensitive hearing because I have a very difficult time filtering my senses, tests can be hard. Since I wasn't your typical idea of what an autistic person looks like, nor did I struggle in

school, I didn't find out until I was 20 years old. Although I did have some struggles that were more obvious earlier on. I had flashbacks, was triggered by loud noises, and had fluctuating energy levels. I also found changes to my regular routine very disruptive, like holidays and snow days.

Probably the thing for which I was most grateful was patience. For a long time, I wasn't sure what it was that was giving me so much grief – whether it was mental illness, previous trauma or a neurodivergence, or some combination of all three. I was always very open with my teachers about what I was dealing with because I thought it would help them be better able to help me. I have the same philosophy with doctors. Even if they didn't know how to help me with the root cause of the issue, it allowed them to understand *why* and *how* I was struggling and then we could work together to find a solution. It also made it easier for me to ask for things that I might need, like extensions or a quiet room. I was able to build a relationship with my teachers, even if it was simply familiarity. It also made it a lot simpler to ask for accommodations from my teachers, because I never know how much context to give, so I end up giving nearly all of it.

I had a teacher in high school who, at the beginning of the semester, handed out sticky notes and asked us to write three things that we wanted her to know about us. Whether it be that we have a part time job, we struggle with focus, anything at all that we thought would be helpful for her to know. If there was anything that she was concerned about, or wanted clarification on, she asked us to speak with her during lunch, or during the class. She ended up being one of the most important supports for me. This isn't to say that you need to be completely

involved in all your students' lives, but just saying that awareness and compassion go such a long way. Similarly, I had a professor who gave the students an anonymous (except for student number) survey asking people to be completely honest about what accessibility requirements they had.

One of the most important things you can do for students is to be willing to learn and collaborate. School and learning typically caters to one way of learning, so a little bit can go a long way. Also, please don't assume people are faking a condition, or issue. Not only does that make it that much more difficult for people who need accommodations to be taken seriously, it's also dismissive of the reason why someone would do that in the first place. Maybe they are lacking the base skills and are scared to ask questions for fear of being shamed for doing so, so they resort to cheating. Instead of assuming the worst, try to be compassionate and work with your students to find a solution.

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