Checklist for Making Science Labs Accessible for Students with Disabilities

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1. Introduction

All students should be able to safely access science laboratories, but the physical layout of standard lab design does not accommodate users with a range of abilities. Applying the principles of universal design – "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Center for Universal Design, 1997) – during the design and construction phases of these spaces would significantly improve the accessibility of laboratories. The use of universal design, however, may not entirely eliminate the need for individual accommodation for persons with disabilities, depending on the type of science lab, course (such as biology or chemistry), impact of the disability, and environment (DO-IT, 2013). Supporting the independence and inclusion of persons with disabilities in the laboratory may also require practical assistive solutions (Hilliard, Dunston, McGlothin, and Duerstock, 2011).

Resource:

- Principles of Universal Design

2. Scope

This *Physical Accessibility Checklist: Making Science Laboratories Accessible for Students with Disabilities* relates to dry and wet teaching and research laboratories.

This checklist focuses on specific areas of a laboratory but does not cover every architectural detail (for example, flooring requirements). For more specific accessibility requirements, see the City of London's *Facility Accessibility Guidelines*, 2007; Brock University's *Accessibility Guidelines*, 2008; and the City of Winnipeg's *Facility Accessibility Guidelines*, 2010. The City of Winnipeg and Brock University had referred to the London's guidelines as they developed their standards. We recommend that you choose the standard with the highest level of accessibility; where possible, this checklist contains these standards.

We also recommend that you refer to Hilliard, Dunston, McGlothin, and Duerstock, (2011): *Designing beyond the ADA – Creating an accessible research lab for students and scientists with physical disabilities*. Institute for Accessible Science: Purdue University. This excellent resource provides images and specific recommendations for designing an accessible laboratory.

3. Target Audience

This checklist is targeted at undergraduate and graduate science laboratory coordinators, faculty, teaching assistants, disability services offices, facilities departments, and capital projects teams in higher education.

4. Space and Reach Requirements

- ☐ Place equipment, chemicals, safety equipment (such as fire extinguishers and spill kits), controls, and operating mechanisms at a height that is accessible from a seated position and limits extended reaching (Brock University, 2008; Disabilities, Opportunities, Internetworking, and Technology [DO-IT], 2012; Miner, Nieman, Swanson, and Woods, 2001; Moon, Todd, Morton, and Ivey, 2012). Operating mechanisms and controls (for example, light switches, fire extinguishers and fume hoods) should be located a minimum of "850 mm (33 ½ in.) to 1200 mm (47 in.) above the floor" (City of Winnipeg, 2010, p. 26). While the literature provides a range of accessible heights, lab designers should refer to the lower reach range.
- ☐ Avoid positioning equipment in places that would require students to reach over dangerous/harmful chemicals, flames, etc. (Farrel, 2001; Moon et al., 2012).
- ☐ Provide work space and equipment that accommodates both left-handed and right-handed users (DO-IT, 2012; Miner et al., 2001; Moon et al., 2012; Neely, 2007). Note: This illustrates a universal design principle. For example, a student may have had a stroke that impacts the right side of his/her body or may be left-handed; in either case, he/she would find it is easier and safer to work in the lab).

For more details on space and reach ranges, see the City of Winnipeg's Accessibility Standards (2010).

5. Accessible Routes and Path of Travel

- ☐ Ensure that the laboratory is located on an accessible route, with an elevator in proximity and unobstructed pathways providing access to the lab entrance (Disability Service Provider J).
- ☐ Provide a minimum clear aisle width of 1100 mm (43 ¼ in.). The preferred width is 1830 mm (72 in.), which allows two wheelchair users to pass each other (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010). In the laboratory context, consider the placement of lab stools protruding into aisles.
- ☐ Ensure sufficient space for persons with mobility devices to turn around (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010; Miner et al., 2001, p. 63).

- ☐ Make sure that the routes and paths of travel are free of obstructions (such as chairs, lab stools, and knapsacks) for safe navigation from the entrance to exit (Burgstahler, 2012; DO-IT, 2013; Neely, 2007; Moon et al., 2012). Note: Regularly monitor for obstructions to guarantee safe and quick access to exits and emergency equipment, such as eyewash stations and showers, to mitigate risks (Disability Service Provider A; Disability Service Provider D; Miner et al., 2001; Royal Society for Chemistry, 2009).
- ☐ Maintain a consistent furniture layout to allow persons with low vision or blindness to navigate safely, especially if they have already received orientation and mobility training and become familiar with the lab's layout (Asher, 2001; Disability Service Provider G).
- ☐ Avoid installing protruding objects (such as a fire extinguisher, sinks, signage, and equipment) from walls, ceilings, and other locations within paths of travel (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010).
- ☐ Where possible, provide exits on each end of aisles with sufficient space to turn (Miner et al., 2001, p. 63). This also facilitates navigation, especially if there is an emergency (Blake-Drucker, 2009). See City of London FADS 4.1.1. for information on turning space. Note: It is important to consider various mobility devices, such as scooters and wheelchairs, when planning turning spaces.

5.1 Doors

- ☐ Install automatic door openers, because persons with physical disabilities may have difficulty opening them independently and "reliance on assistance from others to open doors is not an accessible or dignified solution" (Brock University, 2008, p. 16; City of London, 2007, p. 16; City of Winnipeg, 2010, p. 114). Before positioning openers, take into account the use of the space, obstructions, and volume of traffic, as well as the possibility of keeping the doors open instead of installing an opener. Install power door openers on main entrances and in corridors that are intersected by a series of doors that cannot be held open. It is also best to install openers on laboratory doors through which individuals who carry items would need to maneuver (from an instrument room to a laboratory, between glass wash and sterilization rooms, etc.). This is also a universal design feature in that it would also assist individuals with, for example, carts moving between rooms. Note: Consider using sensor door operators if there is a concern about contamination and touching openers.
- ☐ Supply electrical back-up power for lighting and door openers on laboratories where persons with disabilities may be working alone (for example, in a research laboratory).
- ☐ Install openers adjacent to the automatic door opener button (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010). Note: It can be difficult for persons using a wheelchair or scooter to access openers on a door jamb, because they will generally need to reach out to the control and then back up before moving through the door.

- [ ] Where openers are not installed, ensure that the door hardware requires minimal force or resistance. More specifically, “22 N (4.6 lb.) for interior hinged doors; and 22 N (4.6 lb.) for sliding or folding doors” (Brock University, 2008, p. 18; City of London, 2007, p. 18; City of Winnipeg, 2010, p. 116). If the weight of a door exceeds this, a power door operator is required.
- [ ] Do not use frameless glass doors (Brock University, 2008, p. 16; City of London, 2007, p. 16; City of Winnipeg, 2010, p. 114; Disability Service Provider A). These doors are generally very heavy, and it would be costly to install power door operators afterward.
- [ ] For doors that close automatically due to fire, ensure that the hardware will allow the door to remain open long enough for a person using a mobility device to move through it (Smyser, 2003). The length of time the door takes to close must comply with the fire code.
- [ ] Do not recess doors into walls, so they do not open into corridors. Preferred are sliding doors on sensors, because they allow users to move between spaces and improve the amount of space in which to maneuver. However, it is essential the sliding door is on a sensor; otherwise, manual sliding doors can be inaccessible for some people with disabilities.
- [ ] Position a decal strip, at eye level, on window and door glazing for those who are blind or have low vision. Be sure to provide contrast for the surrounding area to increase safety and visibility (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010).
- [ ] Do not use door handles that require tight grasping or pinching; instead, install lever handles (see *Section 7: Controls and Operating Mechanisms*).

For more details on accessible doors and thresholds, see the City of London’s *Facility Accessibility Guidelines*, 2007; Brock University’s *Accessibility Guidelines*, 2008; and the City of Winnipeg’s *Facility Accessibility Guidelines*, 2010. It is recommended that you choose the standard with the highest level of accessibility.

6. Ground and Floor Surfaces

- [ ] Provide non-slip and non-glare surfaces on floors (Brock University, 2008; City of London, 2007, City of Winnipeg, 2010).
- [ ] Keep ground and floor surfaces well maintained to ensure that there are no trip hazards (Royal Society for Chemistry, 2009).
- [ ] Strongly contrast the colour of the floor with the colour of the surrounding areas, such as baseboards, walls, and door frames (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010).
- [ ] Strongly contrast the colour of the floor with the colour of lab work surfaces.

For more details on ground and floor surfaces, see the City of London's *Facility Accessibility Guidelines,* 2007; Brock University's *Accessibility Guidelines*, 2008; and the City of Winnipeg's *Facility Accessibility Guidelines*, 2010. It is recommended that you choose the standard with the highest level of accessibility.

7. Controls and Operating Mechanisms

- ☐ As noted in *Section 4: Space and Reach Requirements*, position controls and operating mechanisms at a height that is accessible from a seated position (Brock University, 2008; DO-IT, 2012; Miner et al., 2001; Moon et. al, 2012). This includes alarm pull stations.
- ☐ Use single-lever handles and controls that do not require tight grasping or twisting, because they are more useable than knob controls or cross-shaped handles (Burgstahler, 2012; City of London, 2007; DO-IT, 2013; Moon et al., 2012). In some cases, as on fume hoods, replacing the controls with "larger blade-style handles [will facilitate] ease of use and independence" (Hilliard et al., 2011).
- ☐ Place electrical outlets at the front of counters/workstations to ensure that they can be reached from a seated position (Brock University, 2008; Miner et al., 2001). This also reduces the need to reach over dangerous chemicals, etc.
- ☐ Install light switches that can be reached from a seated position (Blake-Drucker, 2009; Miner et al., 2001). See *Section 4: Space and Reach Range.* For task lighting, place light switches at the front of workstations (Blake-Drucker, 2009).
- ☐ Ensure that controls and operating mechanisms (such as equipment valves, gas jets, water faucets, door hardware, and light switches) use less than 22N (5 lbs.) of pressure or force to operate (Brock University, 2008; City of London, 2007; Miner et al., 2001; Smyser, 2003; Moon et al., 2012).
- ☐ Provide flexible connections to electrical, water, and gas lines (Burgstahler, 2012; Disability Service Provider E; Disability Service Provider H; DO-IT, 2013; Miner et al., 2001). This should be done keeping in mind any electrical safety requirements.
- ☐ Strongly contrast the colour of controls and operating mechanisms with the colours of adjacent spaces (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010).

For more details on controls and operating mechanisms, see the City of London's *Facility Accessibility Guidelines*, 2007; Brock University's *Accessibility Guidelines*, 2008; and the City of Winnipeg's *Facility Accessibility Guidelines*, 2010. It is recommended that you choose the standard with the highest level of accessibility.

8. Demonstration Areas

- ☐ Arrange preferential seating for demonstrations, ensuring that demonstrations are visible from a range of heights (Brock University, 2008; Burgstahler, 2012).
- ☐ Arrange seating/standing room in closer proximity to the demonstration for those with mobility, vision or hearing loss. Consider the need for additional space if students require attendants, sign language interpreters, computerized note-takers, or service animals (Disability Service Provider A; Disability Service Provider C; Disability Service Provider F).
- ☐ If required, install mirrors to facilitate viewing of demonstrations (Brock University, 2008; Burgstahler, 2012; DO-IT, 2013; Moon et al., 2012). Cameras with enlarged screens may also be helpful (Disability Service Provider A; DO-IT, 2013; Moon et al., 2012).

9. Workstations and Furniture

- ☐ Include an adjustable-height workstation in each laboratory (Blake-Drucker, 2009; Burgstahler, 2012; Disability Service Provider A, C, and D; DO-IT, 2013; Hilliard et al., 2011; Langley-Turnbaugh, Murphy, and Levine, 2004; Miner et al., 2001; Moon et al., 2012; Smyser, 2003). Adjustable workstations can “accommodate low stature or seated researchers or [can be] raised for those who stand” (Hilliard et al., 2011). Electronically adjustable workstations are preferred, especially in teaching labs where multiple people use the same workstation.
- ☐ Laboratories should have “at least 3% but no less than one” accessible workstation (Brock University, 2008, p. 99). Place equipment on adjustable-height workstations.
- ☐ Provide additional space at the accessible workstation for an assistant, service animal, and/or additional assistive equipment such as a large screen monitor (Brock University, 2008; Disability Service Provider A and C). As well, some students may be working “from trays mounted on their chairs” (DO-IT, 2013).
- ☐ In labs with limited space, create removable sections of workstations so students will have sufficient maneuvering room of 915 mm/36 in. (Blake-Drucker, 2009).
- ☐ Apply a non-glare finish to workspaces (Brock University, 2008, p. 99).
- ☐ Provide a “clear floor space of not less than 900 mm (35 ½ in.) by 1500 mm (59 in.)” (City of Winnipeg, 2010, p. 134).
- ☐ Make sure the top of a work surface is 760 mm (30 in.) from the floor (DO-IT, 2013; Miner et al., 2001).
- ☐ Allow 735 mm (29 in.) of clearance under the countertop, with a depth of at least 510 mm (20 in.) and a minimum width of 915 mm/36 in. (DO-IT, 2013; Miner et al., 2001).
- ☐ Where possible, “create alternative workspaces such as pullout or drop leaf shelves and countertops, or lap-desks” (DO-IT, 2013).
- ☐ Location:
    - Place accessible workstations in close proximity to the sink, eyewash station and shower.

- Where possible, include the sink in the workstation so users do not need to navigate through the lab, thereby increasing safety (Disability Service Provider C; Miner et al., 2001, p. 65).
- Create accessible workstations with fume hoods to enhance a student's efficiency in the lab, and make sure the student has room to safely maneuver around the lab (Hilliard et al., 2011).
- Where possible, locate workstations near natural light (Disability Service Provider C).
- Place accessible workstations closer to the exits to facilitate navigation (Asher, 2001; Miner et al., 2001).
- Also place accessible stations at the ends of aisles (Miner et al., 2001).
- Make sure that students at their workstations have a clear line of sight for demonstrations, including ensuring that other students are not standing and an obstructing a seated person's view (Moon et al., 2012).

- [ ] Ensure storage cabinets have accessibility features, such as castors on the cabinet or a Lazy Susan to access material (Burgstahler, 2012; DO-IT, 2013; Moon et. al, 2012). A minimum of 50% of the shelves and storage cabinets should meet accessibility requirements (Brock University, 2008). See *Section 4: Space and Reach Range.*
- [ ] Consider rounding sharp corners on workstations, where possible (Moon et al., 2012, p. 54).
- [ ] Select hardware for storage drawers and cabinets with U-shaped handles (Blake-Drucker, 2009; Brock University, 2008; City of London, 2007; City of Winnipeg, 2010). U-shaped/or D-pulls allow users to employ devices, such as a reacher or a pole, to open drawers (Blake-Drucker, 2009; Miner et al., 2001).

10. Fume Hoods

- [ ] In keeping with the percentage of accessible workstations required, "at least 3% but no less than one [fume hood should] be accessible" (Brock University, 2008, p. 99; Disability Service Provider A).
  Place fume hoods in spaces that comply with the same principles for knee and floor space as workstations and sinks (Moon et al., 2012, p. 53). For more about knee space, see *Section 9: Workstations and Furniture.*
- [ ] Provide fume hoods that veer forward, because it is difficult to work safely and comfortably from the side.
- [ ] Install adjustable fume hoods with flexible exhaust connections (Disability Service Provider E and G; Smyser, 2003). As well, "a connected cup sink, air baffle and spill tray [should] adjust accordingly" (Blake-Drucker, 2009). If an adjustable fume hood is not suitable or adequate, it may be more appropriate to use an accessible walk-in fume hood with an adjustable table/workbench, depending on the task and type of equipment being used.

- [ ] Purchase sashes on fume hoods with proximity sensors with hand and foot controls that provide maximum flexibility and accessibility. An alternate, if needed, would be a fume hood sash with horizontally movable glass panels. This allows a person using a mobility device to reach into the fume hood with the assurance of face and body protection that would not be present with a vertical sliding sash.
- [ ] Apply the controls and operating mechanisms guidelines (see *Section 7: Controls and Operating Mechanisms*) to fume hoods. In addition, “knobs should be both visually and tactically differentiated…. [For example,] danger is seen with red paint, and felt with rough finish. Spill and low air flow alarms, likewise, are both visual and auditory to ensure notice for those occupants with sensory complications” (Blake-Drucker, 2009).

11. Sinks

- [ ] Install a sink in adjustable workstations, where possible (Blake-Drucker, 2009; Disability Service Provider D).
- [ ] Install a faucet at the side of the sink, located closer to the front corner (Brock University, 2008, p. 99; Hilliard et al., 2011).
- [ ] Install faucets activated by sensors or long levers (paddle style), with sensors being preferred.
- [ ] Where possible, install laboratory sinks that are “available from three sides for those who have mobility/dexterity restrictions on one side” (Moon, et. al, 2012, p. 55-56).
- [ ] Ensure that the surface underneath the sink is smooth and free of sharp objects (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010; Moon et al., 2012).
- [ ] Provide 735mm (29 in.) for knee clearance under the sink (Hilliard et al., 2011).
- [ ] Ensure that the sink rim is no higher than 865 mm (34 in.) from the floor (Moon et al., 2012).
- [ ] Insulate drainpipes under the sink to avoid contact with the hot water supply (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010; Moon et al., 2012; Hilliard et al., 2011; Smyser, 2003).
- [ ] Install touchless paper towel dispensers (Hilliard et al., 2011).

12. Emergency Showers and Eyewash Stations

According to the Canadian Centre for Occupational Health and Safety (CCOHS, 2010), “the first 10 to 15 seconds after exposure to a hazardous substance, especially a corrosive substance, are critical. Delaying treatment, even for a few seconds, may cause serious injury. Emergency showers and eyewash stations provide on-the-spot decontamination. They allow workers to flush away hazardous substances that can cause injury.” The accessibility of emergency showers and eyewash stations for persons with disabilities is therefore essential.

The CCOHS also notes that “currently there is no Canadian standard for the design or placement of eyewash stations or emergency showers. As a result, the American National Standards Institute (ANSI) Standard Z358.1-2009 ‘Emergency Eyewash and Shower Equipment’ is generally used as a guide.” This checklist addresses specific standards and underscores the importance of factoring in the needs of persons with disabilities when determining the location of emergency showers and eyewash stations.

- ☐ The ANSI standard “recommends that a person be able to reach the equipment in no more than 10 seconds. In practical terms, consider that the person who needs the equipment will be injured, and may not have use of their vision. ANSI notes that the average person can walk 16 to 17 metres (55 ft) in 10 seconds, but this does not account for the physical and emotional state of the person. However, the ‘10 second’ rule may be modified depending on the potential effect of the chemical. Where a highly corrosive chemical is used, an emergency shower and eyewash station may be required within 3-6 metres (10-20 ft) from the hazard” (CCOHS, 2010).
  - The eyewash station and shower should “be on an unobstructed path between the workstation and the hazard. (Workers [students] should not have to pass through doorways or weave through machinery or other obstacles to reach them)” (CCOHS, 2010). If the eyewash station and shower are placed outside of the lab (for example, in the corridor), a door separates the rooms, creating an obstruction and increasing the time a person with a disability would need to access emergency equipment. This is particularly problematic if the person has slow mobility or must wait for an automatic door to open. It is best to locate the eyewash station and shower within the room where chemicals are used.
  - Locate eyewash stations and emergency showers in close proximity to the accessible workstation (Miner et al., 2001).
- ☐ The eyewash station should be no higher than 735 mm (29 in.) from the floor to the bottom of the station.
- ☐ Where an eyewash station is activated by pulling down a cord, this action should require less than 22N (5 lbs.) of pressure or force to operate (Brock University, 2008; City of London, 2007; Miner et al., 2001; Smyser, 2003; Moon et al., 2012). The pull must be at an accessible height (see *Section 7: Controls and Operating Mechanisms*).
- ☐ Use retractable drench hoses at the sinks as supplemental eyewash stations (Miner et al., 2001, p. 65). However, “drench hoses may supplement, but cannot replace the eyewash unit. A drench hose requires the use of at least one hand, rendering it impossible to hold both eyelids open simultaneously” (University of Toronto, 2010, p. 2).
- ☐ Use dual nozzle eyewash sprays (University of Toronto, 2010).
- ☐ Ensure that faucets comply with *Section 7: Controls and Operating Mechanisms*.
- ☐ Place the shower in a location (for example, an alcove) where the shower pull is not an obstruction (Farrel, 2001; Smyser, 2003).

- [ ] Make sure that the placement and distance of the showerhead from a seated user meets ANSI, CCOHS, or institutional requirements.
- [ ] Provide a “clear floor space of 76 x 122 cm. (30 x 48 in.)” (Moon et al., 2012, p. 54).
- [ ] Provide an extension or additional pull on the shower handle to allow safe use in a seated and standing position (Hilliard et al., 2011). The extension may be a chain or cord that almost touches the floor (Farrel, 2001). The extension should be a no more than 915 mm (36 in.) above the floor (Miner et al., 2001, p. 65).
- [ ] Strongly contrast the colour of the shower pull with the colours of adjacent areas (Farrel, 2001).
- [ ] Provide a firm, slip-resistant floor surface in the shower room (Brock University, 2008; City of London, 2007; City of Winnipeg, 2010; Farrel, 2001).
- [ ] Make sure that the floor drain is not a tripping hazard.
- [ ] Provide an L-shaped grab bar (Farrel, 2001). The grab bar should have “a horizontal component of at least 915 mm (36 in.), mounted horizontally approximately 700 - 800 mm (27 ½ - 31 ½ in.) above the floor, located on the wall so at least 300 mm (11 ¾ in.) of its length is reachable from one side” of the wheelchair (City of Winnipeg, 2010, p. 162). Note: Implement proper procedures for cleaning the grab bar depending on the material or debris in the area.
- [ ] The CCOHS (2010) notes that the “2009 ANSI standard recommends that the water should be ‘tepid.’ The water temperature must be controlled and monitored to ensure it is in good working order as, due to the length of time a person is expected to remain in the water after exposure, the incorrect temperature can cause other health impacts (e.g., hypothermia)” (CCOHS, 2010). Where a person’s disability (such as a spinal cord injury or diabetes) impacts his/her temperature regulation and causes the person to experience a loss of sensation, the temperature of the water is particularly important, because that person’s skin may be more sensitive to cold and hot temperatures (Backstein, Peters, and Neliga, 1993; Canadian Safety Council, 2005). This deregulation of body temperature causes persons with spinal cord injury to be more susceptible to hypothermia and hyperthermia (Karlsson, Krassioukov, Alexander, Donovan, and Biering-Sørensen, 2012).

Resources:

- Canadian Centre for Occupational Health and Safety – Emergency showers and eyewash stations
- A guide to the ANSI Z358.1-2009 Standard for Emergency Eyewashes and Shower Equipment

13. Lighting

- ☐ Natural and artificial lighting are both important for persons who are blind or have low vision (CNIB, 2011). The lighting source, whether it is artificial or natural, "should provide comfortable, evenly distributed light at all working areas, in all circulation routes and in all areas of potential hazard" (Brock University, 2008, p. 84; City of London, 2007, p. 81; City of Winnipeg, 2008, p. 169).
- ☐ Locate accessible workstations close to natural lighting, where possible (Disability Service Provider C).
- ☐ Light sources should be suspended (pendant-mounted) from above the workbench to allow light to reflect from the ceiling to the workstation (Kosniewski and Fiander, 2013). This is preferred "in most laboratory environments because it produces an even and uniform illumination and provides the least amount of shadowing and glare at bench level. When successfully employed, both of these strategies can produce the necessary amount of light for laboratory functions" (Kosniewski and Fiander, 2013).
- ☐ Use Decora rocker light switches, which are easier to manipulate with a closed fist and easier to clean.
- ☐ Install the light switch at the lowest possible level (see *Section 4: Space and Reach Requirements*).

14. Signage

- ☐ Signage must comply with the CNIB Clear Print Guidelines.
- ☐ Emergency signage must be clear with large print and in Braille and include emergency phone numbers, etc. (Burgstahler, 2012; Disability Service Provider A; Farrel, 2001).
- ☐ Provide a Braille first aid kit (Farrel, 2001).
- ☐ Provide Braille on equipment (Burgstahler, 2012; Disability Service Provider A and G; DO-IT, 2012; Farrel, 2001, p. 58; Western University, 2010).
- ☐ Provide signage on drawers, cabinets and shelves indicating what materials are contained inside (University of Guelph, 2005).
- ☐ Hang bulletin boards, emergency information, experiment information (such as graphs, charts, and posters), at a height that can be viewed by a person in a seated position (Blake-Drucker, 2009). This information should be no higher than 760 mm (30 in.) from the ground to the bottom of the sign (Brock University, 2008).

For more details on signage, see the City of London's *Facility Accessibility Guidelines*, 2007; Brock University*'s Accessibility Guidelines*, 2008; and the City of Winnipeg's *Facility Accessibility Guidelines*, 2010. It is recommended that you choose the standard with the highest level of accessibility.

15. Safety

Accessible lab = Safe lab
(Blake-Drucker, 2009)

Safety in science laboratories is critical for everyone, and is generally one of the biggest concerns expressed about students with disabilities participating in the laboratory (Jones, 2002; Disability Service Office F; Disability Service Office G). The perception of safety risks in fact “could inhibit enrollment by students with disabilities in chemistry laboratory courses” (McDaniel, Wolf, Mahaffy, and Teggins, 1994, p. 21). Based on the literature, the lack of participation of students with disabilities in the sciences extends beyond chemistry to other fields of science. However, students with disabilities are familiar with their needs, strengths, and limitations. As such, Jones (2002) argued that these students are “more safe… and are inclined to be more deliberate and forward thinking when doing particularly unusual or extreme experiments” (p. 27).

While health and safety are factored into the design and procurement of equipment and furniture (see Sections 16 and 17), so must the accommodation of persons with disabilities. An institution cannot assume a student with a disability is unable to perform a task safely, or refuse accommodation, without an “objective determination of that fact” (Ontario Human Rights Commission, 2000, p. 5). The institution may need to perform a risk assessment “to evaluate and prioritize the hazards and risks” (CCOHS, 2006). The office responsible for health and safety/risk management could assist in assessing risk and exploring alternatives (for example, a height-adjustable table, a lab assistant for the student with a disability, or personal protective equipment). A risk assessment of the experiments could also be conducted to ensure that the elements of the accommodation plan do not change the overall risk to the student. This may be especially important “in situations where there is not a clear way to control a hazard, or if legislation does not impose a limit or guideline… seek guidance from occupational health professionals such as an occupational hygienist or safety professional about what is the ‘best practice’ or ‘standard practice’ when working in that situation” (CCOHS, 2006).

With this mind, the following recommendations, combined with the above content, serve as a guide to enhance safety standards in laboratories:

- [ ] Provide “pull-cord alarm buttons… to allow people to call for assistance in an emergency. The alarm should sound in an area of the laboratory that is permanently manned during normal working hours” (Royal Society for Chemistry, 2009).
- [ ] Provide visual lab warning signals (Black-Drucker, 2009; Burgstahler, 2012; Disability Service Provider A, D, E, and I; DO-IT, 2013). This is especially important in research labs where a person may be working alone.

- ☐ Ensure that persons with disabilities can reach emergency devices, such as fire alarm pull stations, eyewash stations and showers, spill kits, first aid kits, phones, fume hood, and personal protective equipment (Western, 2010, p. 7-8).
- ☐ Ensure that safety is discussed with each student with a disability, including instructions for preventing and responding to situations that would compromise the safety of the student or others. For example: a tour of lab and safety features, route to exits, accessing spill kits, eyewash stations, handling dangerous chemicals, and what to do in the event of a spill, exposure or injury that may be different from the standard due to the disability.
- ☐ Discuss with the person who has the disability, and possibly staff from the disability services office and staff from health and safety/risk management, whether any personal protective equipment (such as a lab coat, eye protection, face mask/respirator, and gloves) should be modified to fit body type and/or disability (for example, worn only in seated position using a mobility device).
- ☐ Identify if specific personal protective equipment may be required from a seated position. For example, Miner et al. (2001) highlighted that “a seated student’s face may be at the same level as an experiment. A full-face shield may be warranted for certain experiments where safety glasses alone would not provide adequate protection” (p. 64). Another example would be the use of aprons rather than a lab coat for a person using a wheelchair or scooter.
- ☐ Discuss with staff from health and safety/risk management the process to manage chemical spills on a person’s mobility device (such as a wheelchair). For example, how will the contamination of the mobility device be managed?
- ☐ Determine if there are any health and safety risks for a service animal to be in a laboratory. For example, is there a danger to the animal around specific chemicals? If so, is there an alternate accessible location for the service animal to rest safely to avoid moving through the laboratory “where chemicals or other hazardous materials could be present at floor level, including spills?” (National Research Council (US) Committee on Prudent Practices in the Laboratory, 2011). Is there a mat that the service animal can rest on to avoid “chemical residues on the floors?” (Miner, 2001, p. 68). This type of issue (creating space for an animal to rest) could be considered when designing the accessible workstations.
- ☐ Consider if safety training is required for the sign language interpreter, computerized note-taker and/or assistant to the student with a disability (Disability Service Provider F).
- ☐ Ensure that the staff and faculty responsible for safety in laboratories are familiar with the needs of students with disabilities, and that they are aware of the institution’s key contacts (for example, in the disabilities services office, and in health and safety/risk management) for consultation when required.

Resources:

- Alerting devices for hearing loss
  - Emergency Notification
  - Alerting systems

- Farrel, M. (2001). *Adapting emergency procedures on campus for individuals with disabilities*. Association of Higher Education and Disability.
- Making emergency information accessible to the public AODA
- Personal Protective Equipment

16. Design Process

Accessible research and teaching laboratories are essential to ensuring that students with disabilities (and staff and faculty with disabilities) can participate and engage safely in laboratory activities.

To ensure an accessible laboratory design, facility and capital project teams should consult with staff from the disability services office as well as the students with disabilities (this may be achieved through consultation with the disability services or accessibility advisory committees). It might also be valuable to have discussions with staff from health and safety/risk management. Furthermore, for new builds, institutions may find it helpful to hire architects who specialize in accessibility to review the drawings. While such consultations will require investments of finances and time, so does the retrofitting of labs. Moreover, advance consideration of accessibility requirements can help institutions meet the needs of students with disabilities in a timely manner that would otherwise not be possible. If accessibility is an afterthought, the needs of a person with a disability may not be met in a timely manner and the lab retrofits may be costly.

The Canadian Centre for Occupational Health and Safety (2006) also noted that appropriate hazard control often includes conducting a risk assessment. This will provide insight into the hazards and risk. “Both ‘normal’ and any potential or unusual situations must be studied.” The design phase should take into account the hazards and risks for persons with various abilities. When considering how to eliminate or reduce risk, the CCOH (2006) also states that “it is best to design for permanent controls of safety instead of creating the need for temporary controls.” For example, designing for adjustable tables may eliminate risk for some persons with disabilities who need to adjust the table to a safe height to handle chemicals. Without the height-adjustable table, extra precautions, such as the use of additional personal protective equipment, may be needed to temporarily control measures.

17. Procurement

Under the *Accessibility for Ontarians with Disability Act, 2005*, Ontario universities are required to “incorporate accessibility criteria and features when procuring or acquiring goods, services or facilities, except where it is not practicable to do so” (Section 5). It is further recommended that universities “incorporate accessibility criteria in all stages of your procurement practices, including writing and assessing tenders” (Ministry of Community and Social Services, 2013).

The Ministry of Community and Social Services offers the following guidelines for thinking about barriers to products and services:

1. "**Equitable:** can someone with a disability use the good, service or facility as quickly and easily as a person without a disability? For example, if you're hiring a web developer to build a website for your organization, will someone who is blind and using text-to-speech software be able to access the site?

2. **Flexible:** does the good or service accommodate a wide range of individual preferences and abilities? For example, you want to provide training to your staff – can the training be provided in a variety of formats if necessary?

3. **Size and Space for Approach and Use:** Can someone – regardless of their body size, posture, or mobility – approach, reach, manipulate and use the good or facility. For example, you've purchased an accessible picnic table, but have you ensured that someone in a wheelchair can access it?

4. **User-Friendly:** Are the instructions perceptible and intuitive? Can someone with limited physical strength use the good? If someone makes a mistake while using the good, are the adverse consequences minimal?"

Here are some accessibility criteria to consider with different types of purchases:

Type of purchase	**Criteria to consider**
Goods	• Can the good be used by someone: o in a seated position o using one hand, with limited upper body strength, or limited fine motor skills o with vision loss or low vision o with hearing loss • Does the product meet ergonomic standards and can it be customized to meet a variety of needs? • Are support materials, such as manuals, training, or service calls, available in accessible formats at no additional charge?
Services	• Does the firm provide accessible customer service, as required under the Customer Service Standard? • Can the service provider accommodate the needs of people of all abilities? For example, if you're hiring a company to conduct research, do its surveys and interviews accommodate people with different types of disabilities?

	• Will the company use accessible signage, audio, and/or print materials? For example, if you're hiring an event coordinator, will the coordinator use high- contrast signage for the event?
Facilities	• Can someone using a mobility aid, like a wheelchair or walker, get around the facility? • Are signs placed at an accessible height? • Does the facility have emergency procedures to assist people with disabilities?

Compiled from Ministry of Community and Social Services, 2013.

In the laboratory setting, adjustable-height workstations, fume hoods, sinks, and equipment (such as glass vs. plastic beakers, depending on the chemicals used) are some examples of accessibility concerns that must be considered in advance and built into the tender, design, budgets, and purchasing processes.

Sample procurement policies:

- Wilfrid Laurier University
- Nipissing University

Resources:

- Accessible Procurement Toolkit found at http://www.ap-toolkit.info/default.asp
- Ministry of Community and Social Services (2013). *Making your purchases more accessible*.

18. Conclusion

It is essential to ensure that science laboratories are accessible to students, staff, and faculty with a range of abilities. There is a "social impact" when a person is unable to navigate independently and freely throughout the classroom and with his/her peers (Moon et al., 2012). As much as possible, choose the highest accessibility standards to minimize the assistance that a person with a disability will need and "guard against unnecessary intervention that will 'single out' the student" (Moon et al., 2012, p. 51). Finally, since safety is a critical concern, the needs of persons with disabilities must be considered during the design and construction of science laboratories.

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