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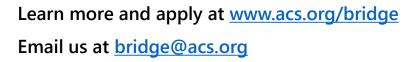


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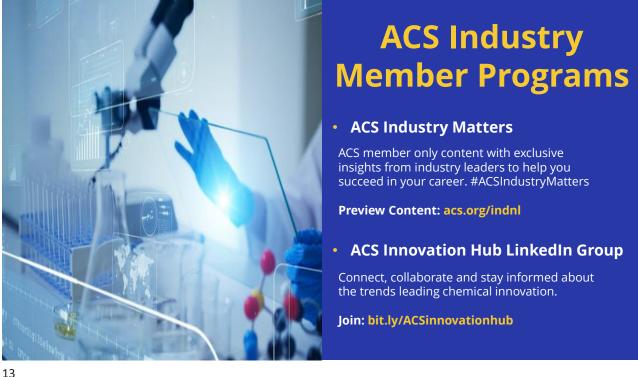




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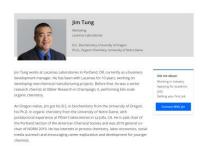


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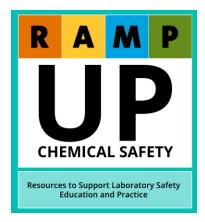
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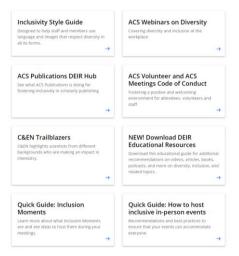


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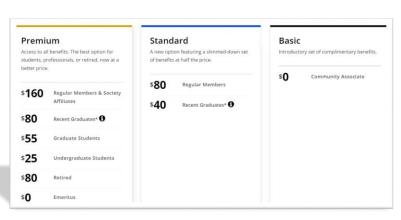
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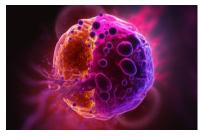
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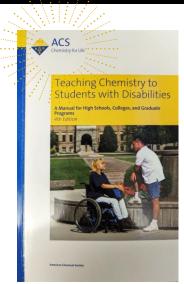
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# Inclusive Science

Brad Duerstock, Ph.D. Professor of Practice

Weldon School of Biomedical Engineering

School of Industrial Engineering

Dept. of Basic Medical Sciences, College of Veterinary Medicine, courtesy Dept. of Health and Kinesiology, College of Health and Human Sciences, courtesy







# Inclusive Science

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#### School of Industrial Engineering

Dept. of Basic Medical Sciences, College of Veterinary Medicine, *courtesy* Dept. of Health and Kinesiology, College of Health and Human Sciences, *courtesy* 

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Why is diversity important?

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Society benefits from participation of all groups of citizens.

- 20% of population has a disability many are under- or unemployed due to inaccessibility.
- At times fulfills is a national imperative in labor.
- Vocational rehabilitation needs to expand to all labor areas including STEM fields.



US Department of Labor, 1951





Gilbreth and Gilbreth, 1920

"The injured man must be made to feel that he is not an object of charity, but that he is a handicapped contestant in the world of active people." -Frank and Lillian Gilbreth, 19201

### STEM Benefits from Our Contributions



Disability grants unique insights in science and its practice as well as novel ways of perceiving and interacting with the world.

- Notable PWDs have made profound contributions to science.
- 'Lived experiences' provide important insights into medicine and other fields.
- Promote technological advancements
- Alternative methods of interaction with data and lab tools.

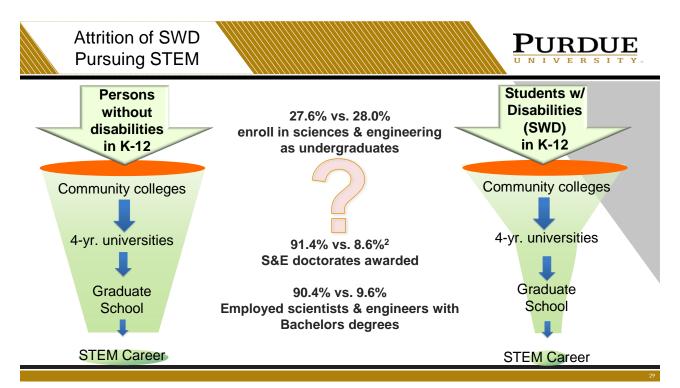


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## Next Steps??

- STEM inclusion involves more than just accessibility.
- Adequate accommodations may involve architectural access, assistive technologies (AT), or alternative working conditions (teleconferencing, extended time, etc.).
- Inclusion like universal design does not need to exclude others.
- There is no one solution. Every student or employee with a disability has unique challenges.



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IAS was established through the NIH Director's Pathfinder Award to facilitate practical or "hands-on" lab research, which is challenging for those with mobility and sensory impairments. Core premises of IAS:

- 1. Activity-based learning is critical to STEM education.3
- 2. Students with physical disabilities often stay away from lab-based undergrad courses due to perceived barriers.<sup>4,5</sup>
- 3. Independent research necessary for graduate students, postdocs and often undergraduate students.<sup>6</sup>
- 4. Understanding how lab equipment works is essential to experimental research design.<sup>7</sup>

## Architectural Access in the Lab







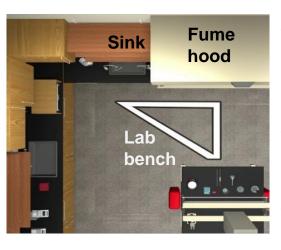


Adjustable-height lab benches, fume hoods, and sinks foster greater independence for students with disabilities in biomedical "wet" labs.<sup>8</sup>

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Architectural
Access in the Lab





- Work triangle of frequently used stations decreases travel time and energy of users.<sup>8,9</sup>
- Reconfigurability of lab stations provides flexible workspaces.
- Overhead fixtures provide flexible use.

## Lab Safety



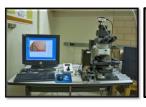
- Accessible emergency shower & eye wash stations
- Clear signage indicating exits and safety equipment
- Motion-sensor Sharps containers, waste cans, and soap & paper towel dispensers are "hands-free" & decreases contamination
- Provide alternative formats for safety documentation



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## Accessible Lab Tools













| \ |                                                                              |                                                                               |  |  |  |  |  |  |  |
|---|------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--|--|--|--|--|--|--|
|   | Low Vision Accommodations for Veterinary Tasks <sup>10</sup>                 | Pros and Cons                                                                 |  |  |  |  |  |  |  |
|   | Microscope with video camera for histolog and cytology                       | ↑ Intuitive to use.  ↓ Smaller field-of- view than via eyepiece.              |  |  |  |  |  |  |  |
|   | Illuminated head loupe for near viewing (e.g. dentistry gross anatomy)       | ↑ Provides illumination & magnification. ↓ May startle ng near animal's face. |  |  |  |  |  |  |  |
|   | Monocular for long-distance viewing (e.g. observing gait behavior in horses) | ↑ Easy to carry &use. ↓ Limited field of view. Harder to track rapid motions. |  |  |  |  |  |  |  |

## Exploration of Digital Images



#### **Current Solutions**

- Tactile paper and 3-D prints
  - Long time to produce the physical accessible graphics
  - Much less information conveyed
  - Require human assistance to understand visual concepts







#### Solution proposed:

- Haptic virtual graphics
  - Real-time access to digital images with image processing techniques
  - Multimodal interaction
  - Intelligent synchronous assistance



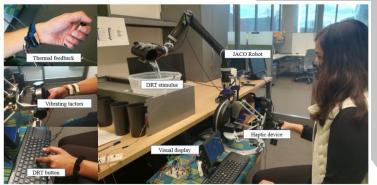
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## Lab Robotics



## Robotic lab assistants may help with conveying or manipulating typical lab equipment.





- Multimodal control includes no-contact robot operation, e.g. gesture & speech recognition<sup>11,12</sup>
- Multisensory feedback provides users remote information, e.g. auditory, haptic, temperature
- All has potential to enable robots to understand human commands and intentions

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## Virtual Lab Training





Virtual lab training prepares students with disabilities prior to developing accessibility solutions.<sup>13</sup>



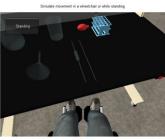


Accessible Biomedical Immersion Lab (ABIL)

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## 3-D Modeling of Lab Use







- enable others to experience the lab from the perspective of SWD.<sup>13</sup>
- Ergonomic analysis of different users model the musculoskeletal strain of repetitive motions.<sup>14</sup>





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Email: <u>bsd@purdue.edu</u>

Duerstock IAS Lab: <a href="https://engineering.purdue.edu/DuerstockIAS">https://engineering.purdue.edu/DuerstockIAS</a>

IAS Hub: https://stemedhub.org/groups/iashub

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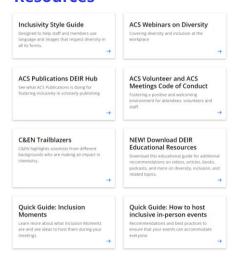


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#### Respect

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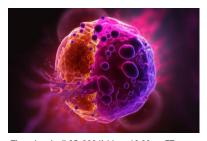
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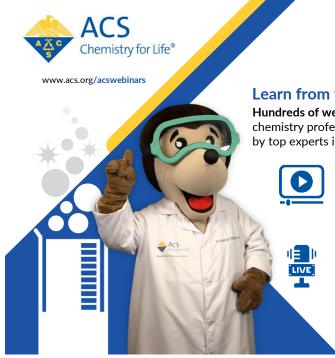
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