Unveiling Molecular Beauty: A Sensory Journey

Christin Monroe, PhD
Happy International Women’s Day!
Outline

• Executive Function Challenges – Strategies to Minimize Sensory Overload

• Blind/ Low Vision – Strategies to Assist B/LV Individuals with Molecular Visualization

• Color Blindness – Tips and Tricks for Color Selection
Disclaimer

• This presentation is not intended to solve all problems with accessibility and assessment for molecular visualization.

• Your assessment strategies must be authentic:
  • To Yourself
  • To your Content
  • To your Students
Landmark College

- Established in 1985
- First institution of higher education to solely serve students with learning disabilities
Neurodiversity at Landmark College

Neurodiversity- Describes a multitude of naturally occurring variations in the brain that result from the human genome.
EXECUTIVE FUNCTIONS AND COGNITIVE LOAD
Executive functions
(work together in various combinations)

- **Activation**: Organizing, prioritizing, and activating to work
- **Focus**: Focusing, sustaining, and shifting attention to tasks
- **Effort**: Regulating alertness, sustaining effort, and processing speed
- **Emotion**: Managing frustration and modulating emotions
- **Memory**: Utilizing working memory and accessing recall
- **Action**: Monitoring and self-regulating action

Cognitive Load

- **WORKING MEMORY CAPACITY**
  - space for UNDERSTANDING
  - METHOD of delivery
  - complexity of INFORMATION

- **GERMANE LOAD**
- **EXTRANEOUS LOAD**
- **INTRINSIC LOAD**
Factors to Consider for Introducing Molecular Visualization Software

• Introduce the software using multiple means of representation that students will always have access to
  • Written tutorial (ideally with screen shots or pictures)
  • Video tutorial
  • Allow time for familiarization/experimentation

• Encourage students to use the "reference guides" while investigating more complex concepts

• Don’t assume mastery and provide opportunities for students to ask questions throughout the use of the software

• Consider how to minimize anxiety and cognitive load as you design your curricula

• Consider what your learning objectives are and what they are not
Strategies to Minimize Anxiety

Create
Create an environment that encourages student questions

Allow
Allow for draft submissions

Encourage
Encourage “failure” not “Failure”
Consider the Priority of Assignments

- Provide time during class to complete important assignments

- Consider assigning videos to supplement reading assignments

- Implement active learning in your class (especially when new technology is introduced)

- Allow for flexibility in submissions (if applicable)
Example of Deadline Flexibility

Suggested Deadline

2-Week Deadline
“Zero” in Gradebook; Assignment can still be submitted

Mid or End Semester Deadline
What I Wish My Instructor Knew: How Active Learning Influences the Classroom Experiences and Self-Advocacy of STEM Majors with ADHD and Specific Learning Disabilities

Mariel A. Pfeifer, Julio J. Cordero, and Julie Dangremond Stanton*  
Department of Cellular Biology, University of Georgia, Athens, GA 30602
Takeaways from Article

• Active learning can be beneficial to students with ADHD because it provides “space for distractions”

• Clicker questions can be useful for student metacognition, but pacing for students is important (especially for graded clicker questions)

• How active learning practices are implemented may have significant effects on student success
Consider Learning Objectives

• Align your learning objectives directly with your assessment

• Consider creating assessments that address mastery of different factors

• Minimize assessment of skills not aligned with learning objectives
Breaking Down Laboratory Tasks

- Laboratory Tasks
  - Learning Objectives
    - Interpreting the instructions
    - Performing the lab
    - Analyze the Data
  - Not learning objectives
    - "Reading" the Instructions
    - Collecting the Data
Breaking Down Laboratory Assessments

These are examples of “reasonable” accommodations.
Sci-Voice Talking Labquest (TLQ) 2

- Reads data off in real time
- Reads instructions to students as they perform the lab
- A tool that can be useful both for blind/low vision and dyslexic science students

Monroe, Christin B. (2023) “B/LV Laboratory Accessibility Technology Adapted for Neurodiverse Chemistry Students”. Journal of Science Education for Students with Disabilities. Vol. 26 : Iss. 1, pp. 1-9, Article 5. DOI: 10.14448/jsesd.15.0004. Available at: https://repository.rit.edu/jsesd/vol26/iss1/5.
More than 50% of neurodivergent students polled found the “idea” of the TLQ 2 helpful.

Monroe, Christin B. (2023) “B/LV Laboratory Accessibility Technology Adapted for Neurodiverse Chemistry Students”. Journal of Science Education for Students with Disabilities. Vol. 26 : Iss. 1, pp. 1-9, Article 5. DOI: 10.14448/jsesd.15.0004. Available at: https://repository.rit.edu/jsesd/vol26/iss1/5.
Molecular Visualization Assessment

- Identify correct PDB code
- Basic Tasks in Mol*
- Effectively Creates Meaningful Visuals
- Draw Conclusions based upon Structure
- Draw conclusions based upon structure

Assessment
Multimodal Approaches for Students with Disabilities
Tactile Bohr Model

Monroe, Christin B.; Stein, Andrew B.; and Tolman, Cindy (2022) "Implementing Tactile Learning to Aid Students Understanding of the Bohr Model," Journal of Science Education for Students with Disabilities: Vol. 25 : Iss. 1, pp. 1-14, Article 3. DOI: 0.14448/jsesd.13.0003
Monroe, Christin B.; Stein, Andrew B.; and Tolman, Cindy (2022) "Implementing Tactile Learning to Aid Students Understanding of the Bohr Model," *Journal of Science Education for Students with Disabilities*: Vol. 25 : Iss. 1, pp. 1-14, Article 3. DOI: 0.14448/jsesd.13.0003
All Students have the Potential to Benefit from BOTH computer models and tactile models
The Many Faces of Heme Case Study

Figure Credit: Jana Villemain
Visualizing 3D imagery by mouth using candy-like models

Katelyn M. Baumer, Juan J. Lopez, Surabi V. Naidu, Sanjana Rajendran, Miguel A. Iglesias, Kathleen M. Carleton, Cheyanne J. Eisenmann, Lillian R. Carter, Bryan F. Shaw*

Handheld models help students visualize three-dimensional (3D) objects, especially students with blindness who use large 3D models to visualize imagery by hand. The mouth has finer tactile sensors than hand, which could improve visualization using microscopic models that are portable, inexpensive, and disposable. The mouth remains unused in tactile learning. Here, we created bite-size 3D models of protein molecules from “gummy bear” gelatin or nontoxic resin. Models were made as small as rice grain and could be coded with flavor and packaged like candy. Mouth, hands, and eyesight were tested at identifying specific structures. Students recognized structures by mouth at 85.59% accuracy, similar to recognition by eyesight using computer animation. Recall accuracy of structures was higher by mouth than hand for 40.91% of students, equal for 31.82%, and lower for 27.27%. The convenient use of entire packs of tiny, cheap, portable models can make 3D imagery more accessible to students.
Takeaways from Article

• The mouth has finer tactile sensors than hand

• Students recognized structures by mouth at 85.99% accuracy – similar to recognition by eyesight using computer animation

• Reusable silicon molds can be used to produce edible models of 3D imagery

• This article has implications beyond blind/low vision individuals
Neurodivergent Student Feedback

• Opportunity to practice Mol* before module

• Color coded steps and guidance to help with seeing the structure in Mol*

• It was motivating to read and apply content to what you are seeing visually

• Implementation of physical models would be useful
Making Accessible Figures for All Senses
**TIPS AND TOOLS**

Some basic principles can be applied to generate accessible images.

- **Do not use rainbows.** Use a perceptually uniform colour map, such as viridis or cividis.

- **Avoid red.** Especially in combination with green.

- **Go grey.** Check your figure in greyscale, or by completely desaturating it.

- **Pick a palette.** Choose one that works for everyone, such as Color Universal Design or Color Blind 10 Palette, or create your own using i want hue or Viz Palette.

- **Think bigger.** Use features such as shapes and line textures to disambiguate colour.

- **Test drive.** Use a simulator such as Color Oracle or Coblis to ensure images can be interpreted accurately by everyone.
Coloring for Colorblindness

Accessible palettes

So what colors *should* you use? The colorpicker tool above is intended to give the freedom to choose your own colors while making sure that your color palette is accessible. But to get you started, here are some ideas. Here are 8 pairs of contrasting colors which maintain their contrast for people who are colorblind. Click on any of them to load it into the color palette selection tool above.

https://davidmathlogic.com/colorblind/
Tools for Making Figures and Websites More Accessible
Accessibility Checker in Powerpoint

To add this to powerpoint simply type “accessibility checker” into the search bar at the top of the screen.
What is alt text and how it is different from captions?

Ask Yourself: What information am I trying to convey with this image in context?

Decorative Icon
You can mark this image as decorative or leave the alt attribute null. It doesn't contribute any useful information to the page.

Alt Text for Different Types of Images

A Group of Students
Alt Text: Four students pose on the shady horseshoe, with the two students in the front throwing their hands up.
A crystal structure of the new antibody shows how fentanyl fits into its binding pocket. Kim Janda/C&EN

Alt text: "A protein structure diagram, with a small molecule docked inside the binding pocket."

Caption: "A crystal structure of the new antibody shows how fentanyl fits into its binding pocket."
Conclusions

• strategies to design curriculum delivery to overcome executive function (EF) challenges

• examples of techniques for teaching blind/low vision (B/LV) students molecular "visual" concepts

• Tips and tools to design accessible figures
Acknowledgements
Additional Resources
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