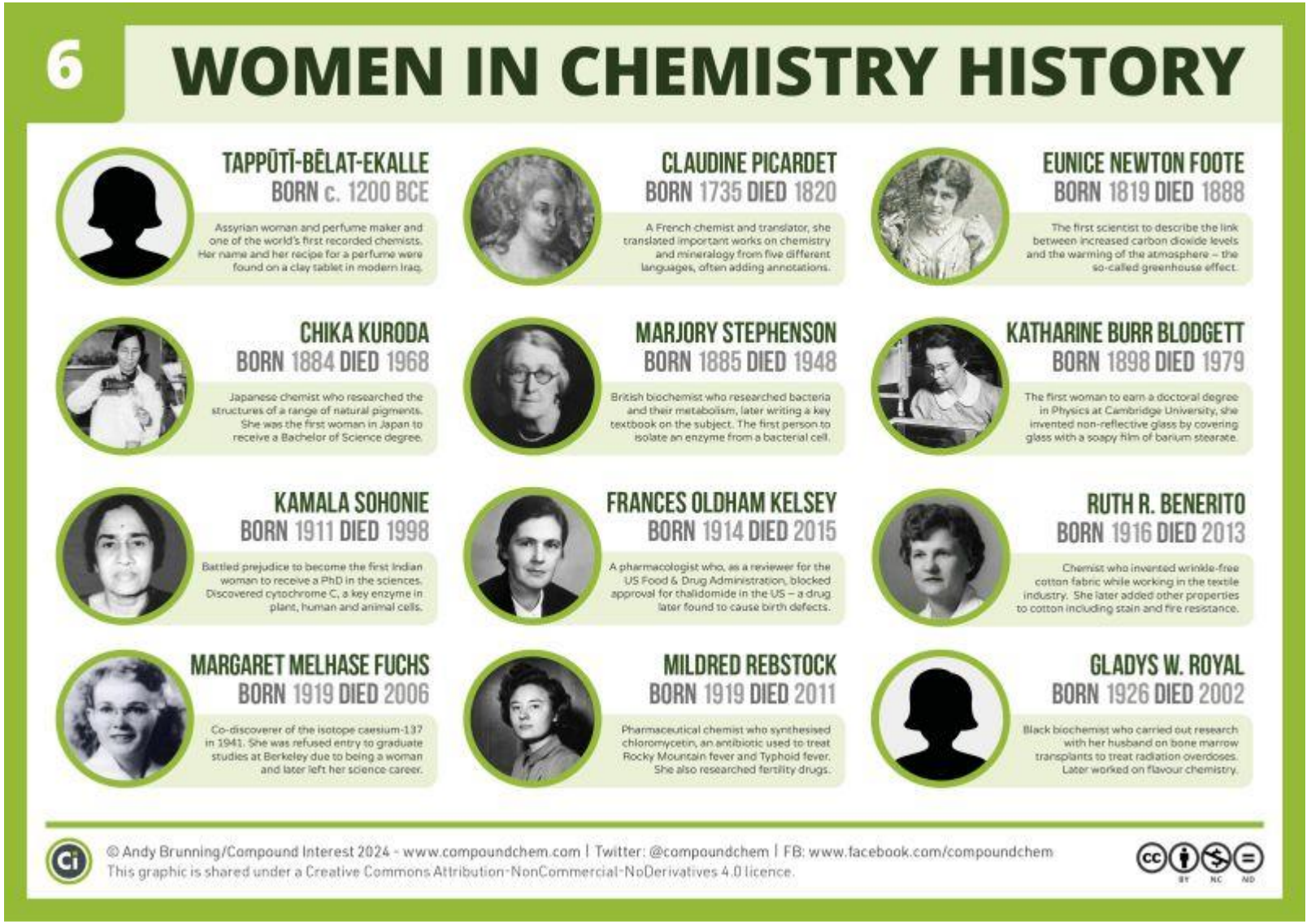
Unveiling Molecular Beauty: A Sensory Journey

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

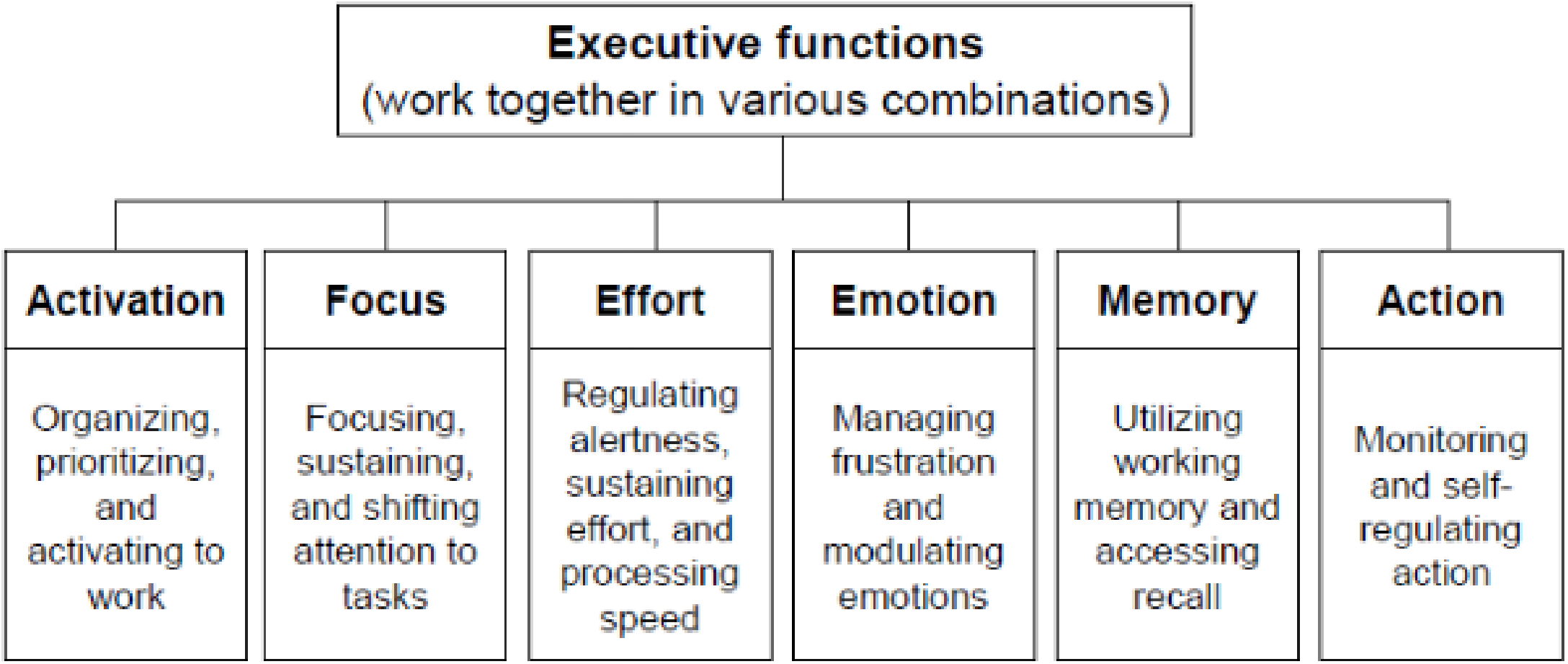
Landmark College

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

Neurodiversity at Landmark College

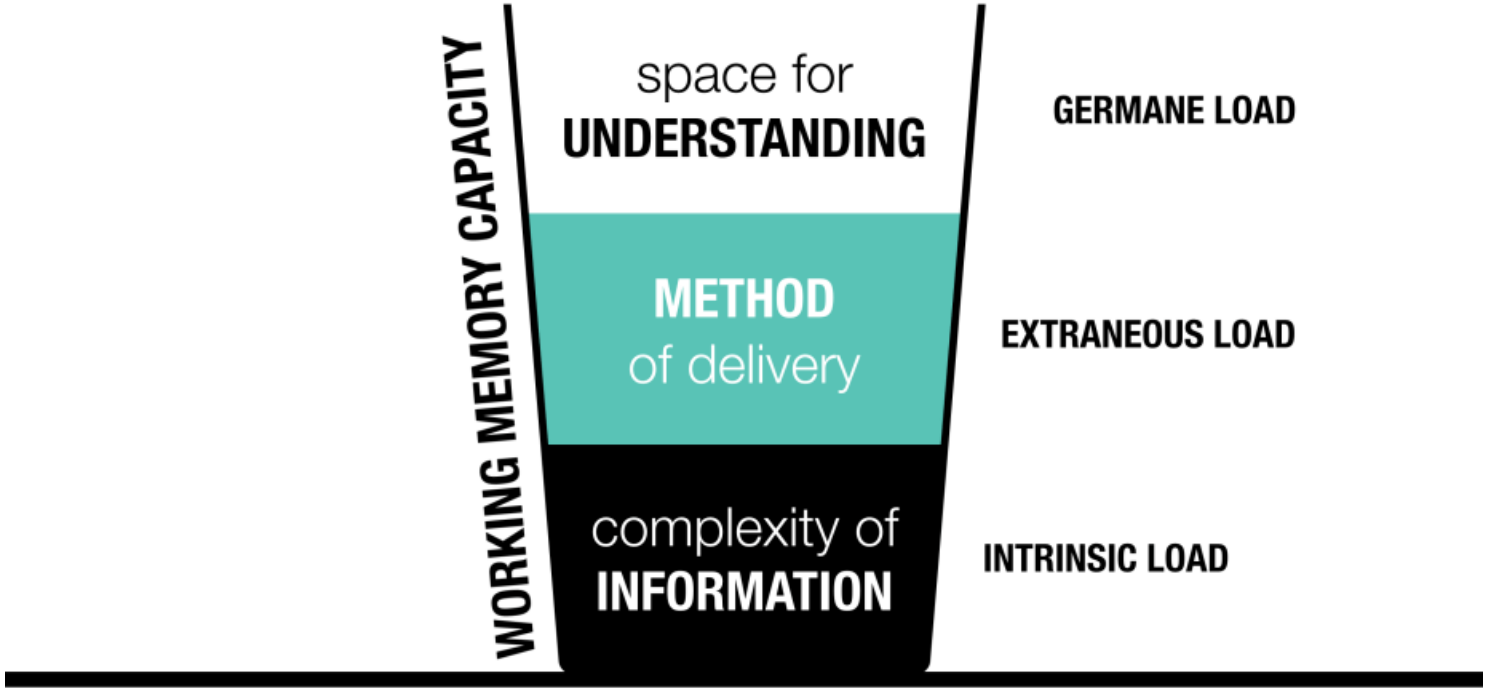
Neurodiversity- Describes a multitude of naturally occurring variations in the brain that result from the human genome.

EXECUTIVE FUNCTIONS AND COGNITIVE LOAD



Brown, T.E. (2001). Manual for Attention Deficit Disorder Scales for Children and Adolescents.

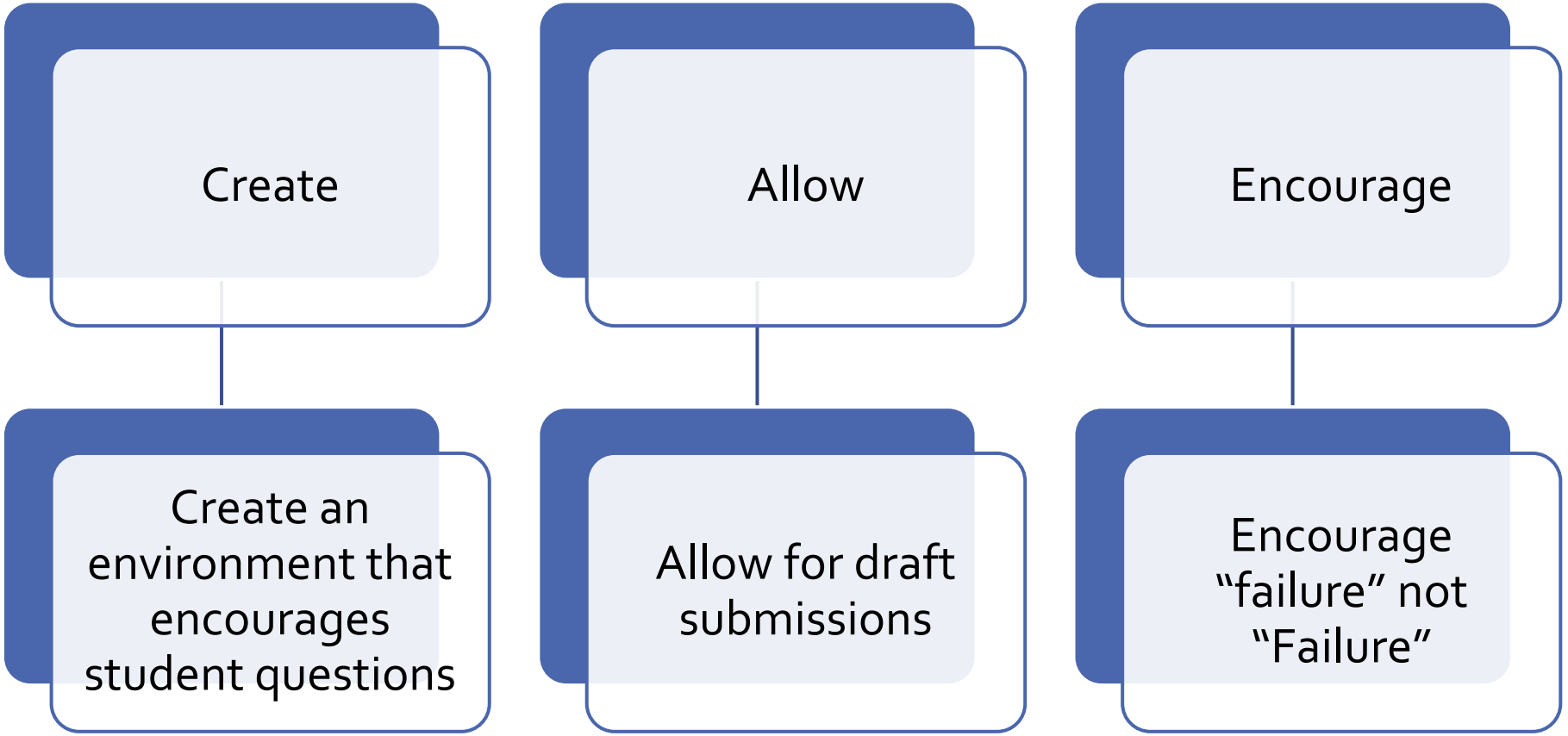
Cognitive Load



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



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

CBE—Life Sciences Education • 22:ar2, 1–20, Spring 2023

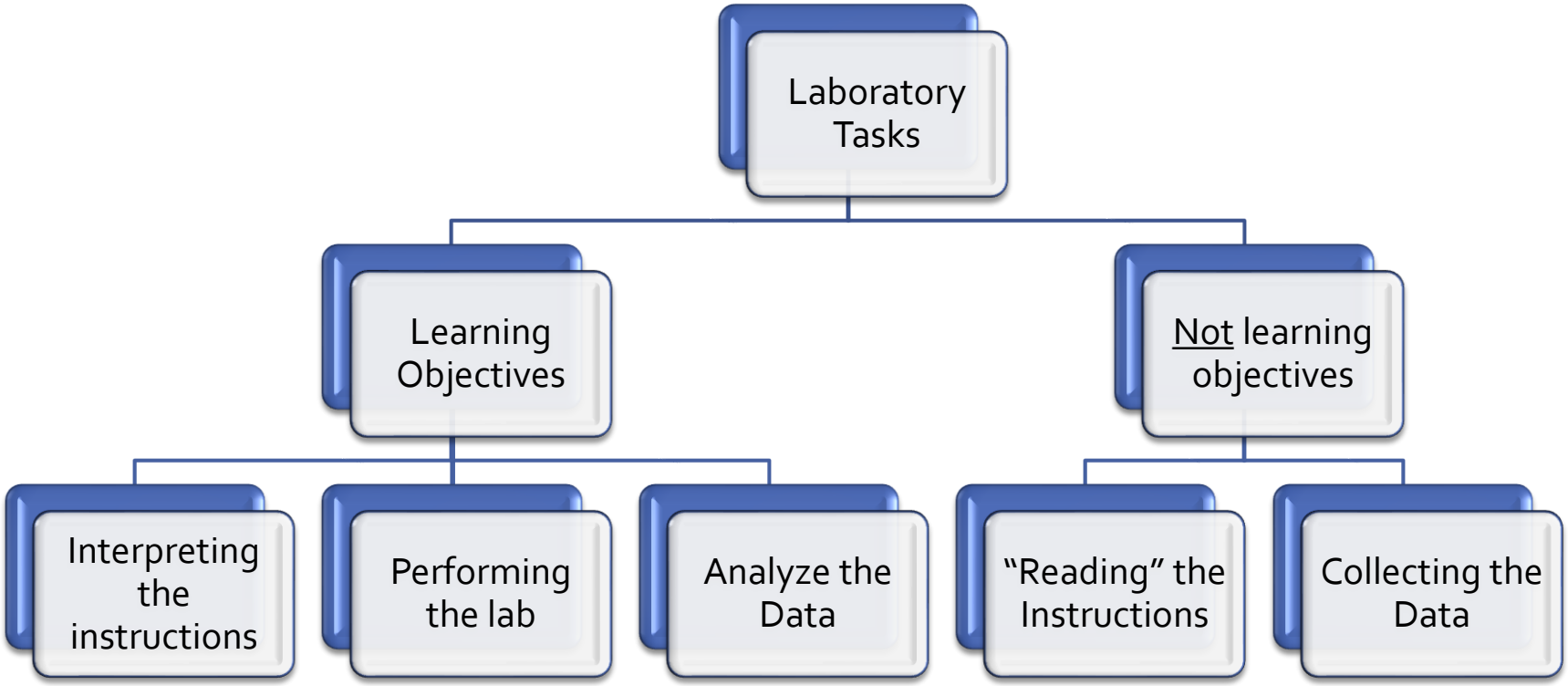
Takeaways from Article

- 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

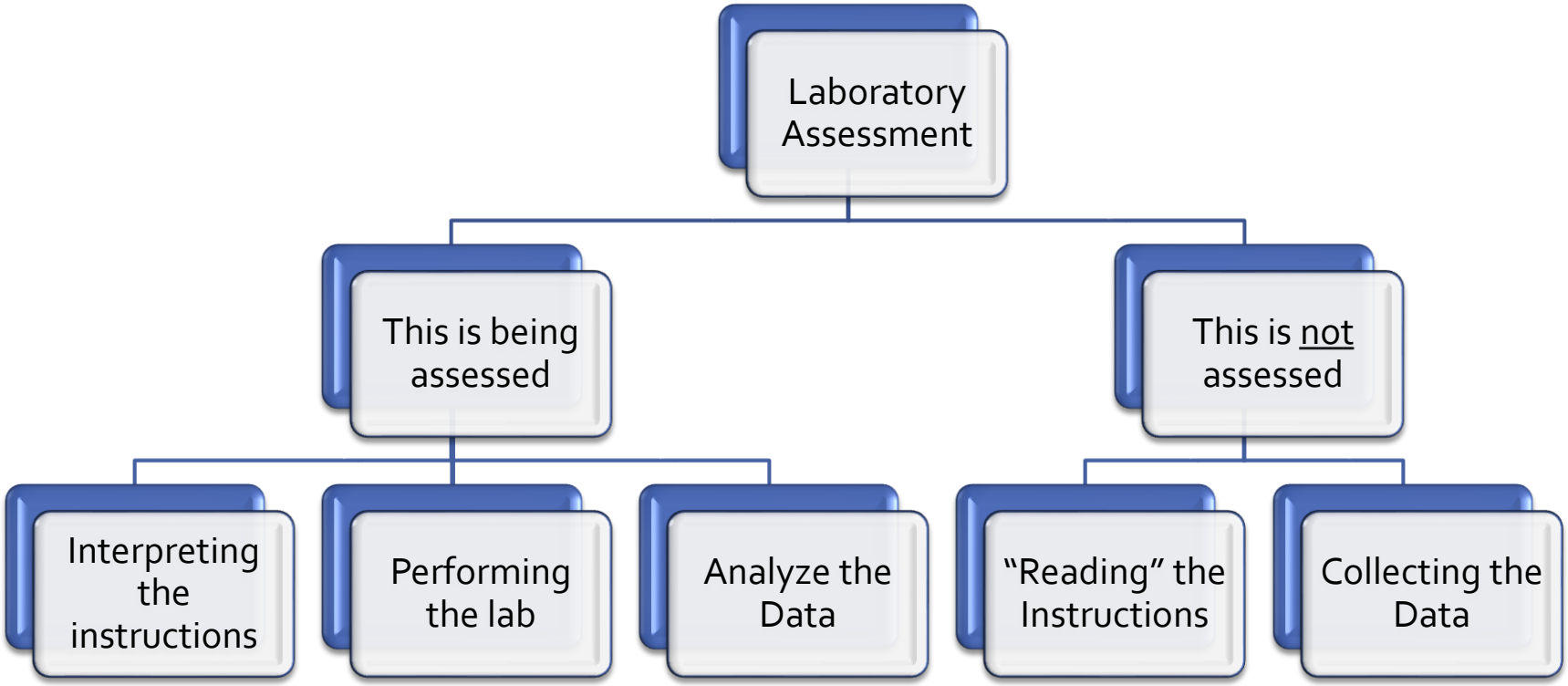
Consider Learning Objectives

- 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



Breaking Down Laboratory Assessments



These are examples of "reasonable" accommodations.

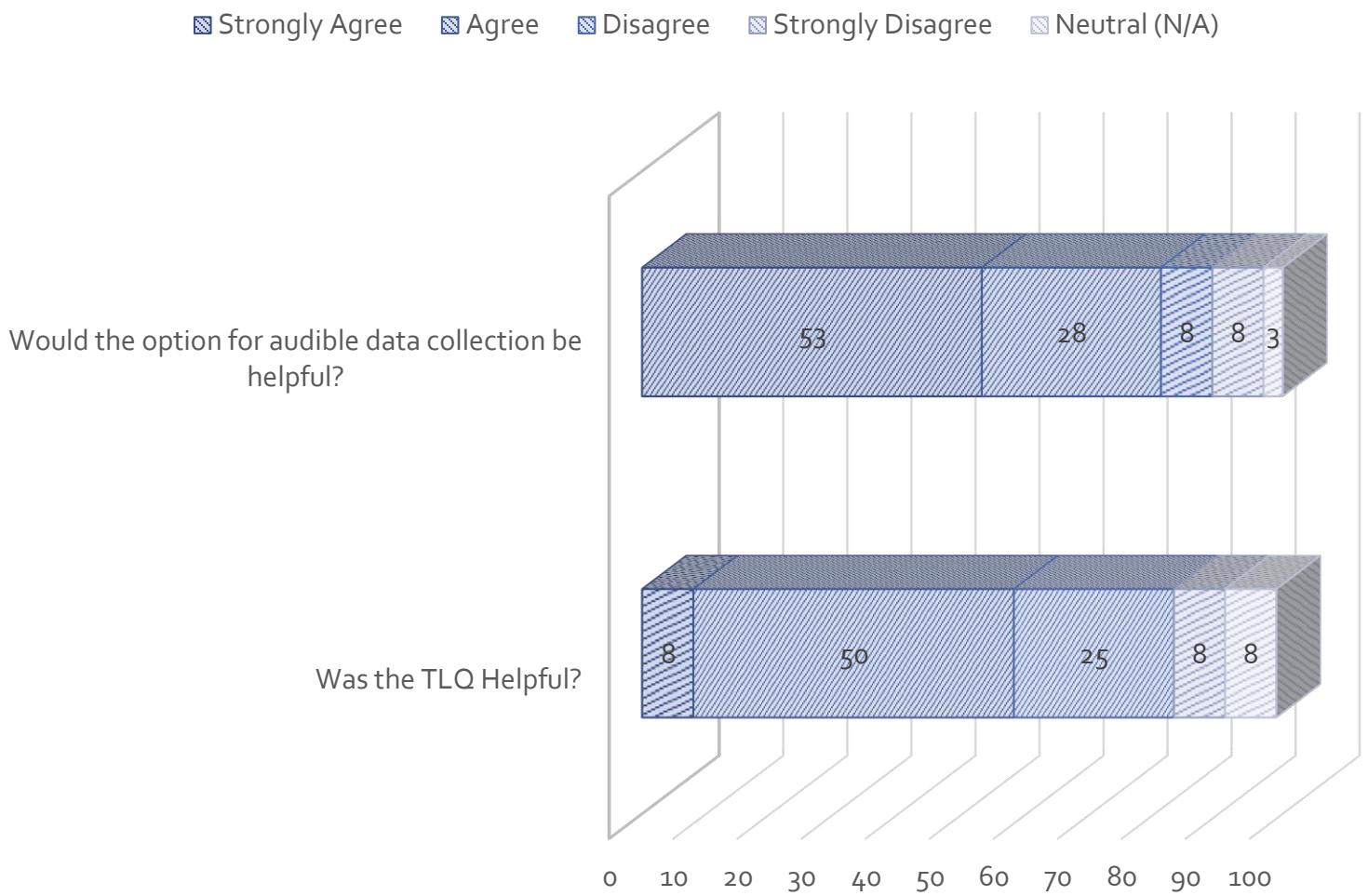
Sci-Voice Talking Labquest (TLQ) 2

- 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.

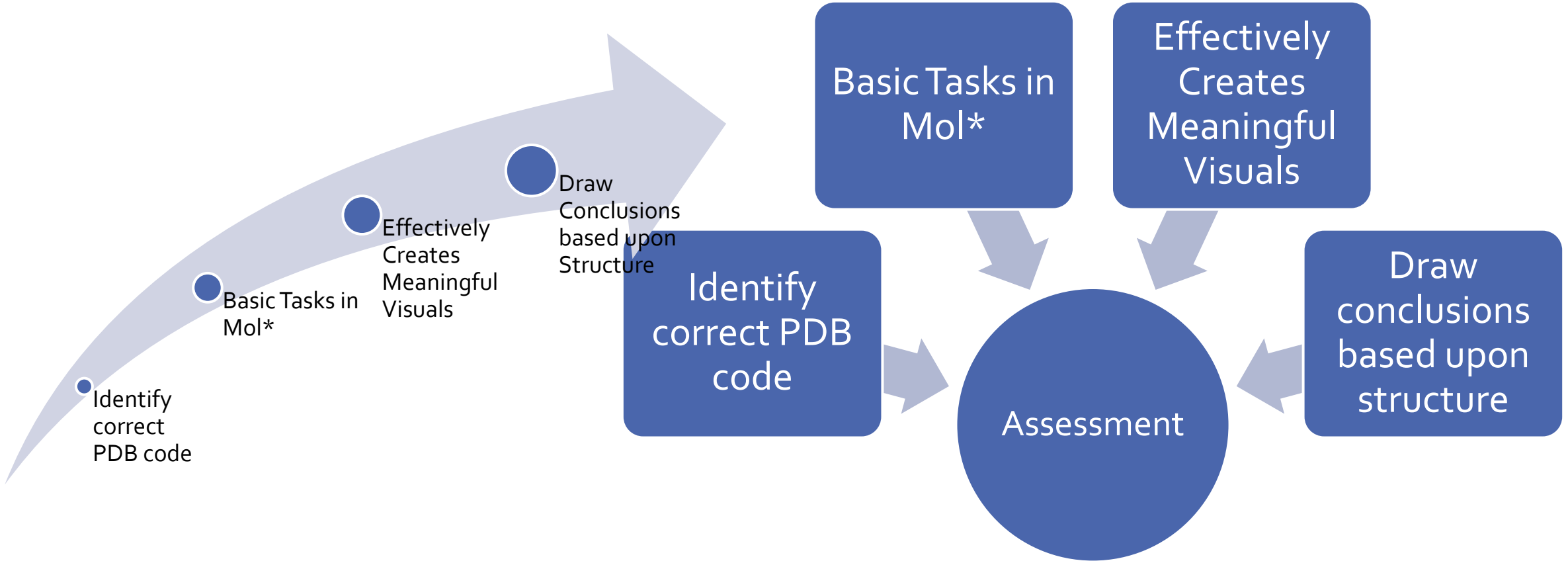
TLQ 2 FEEDBACK

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.

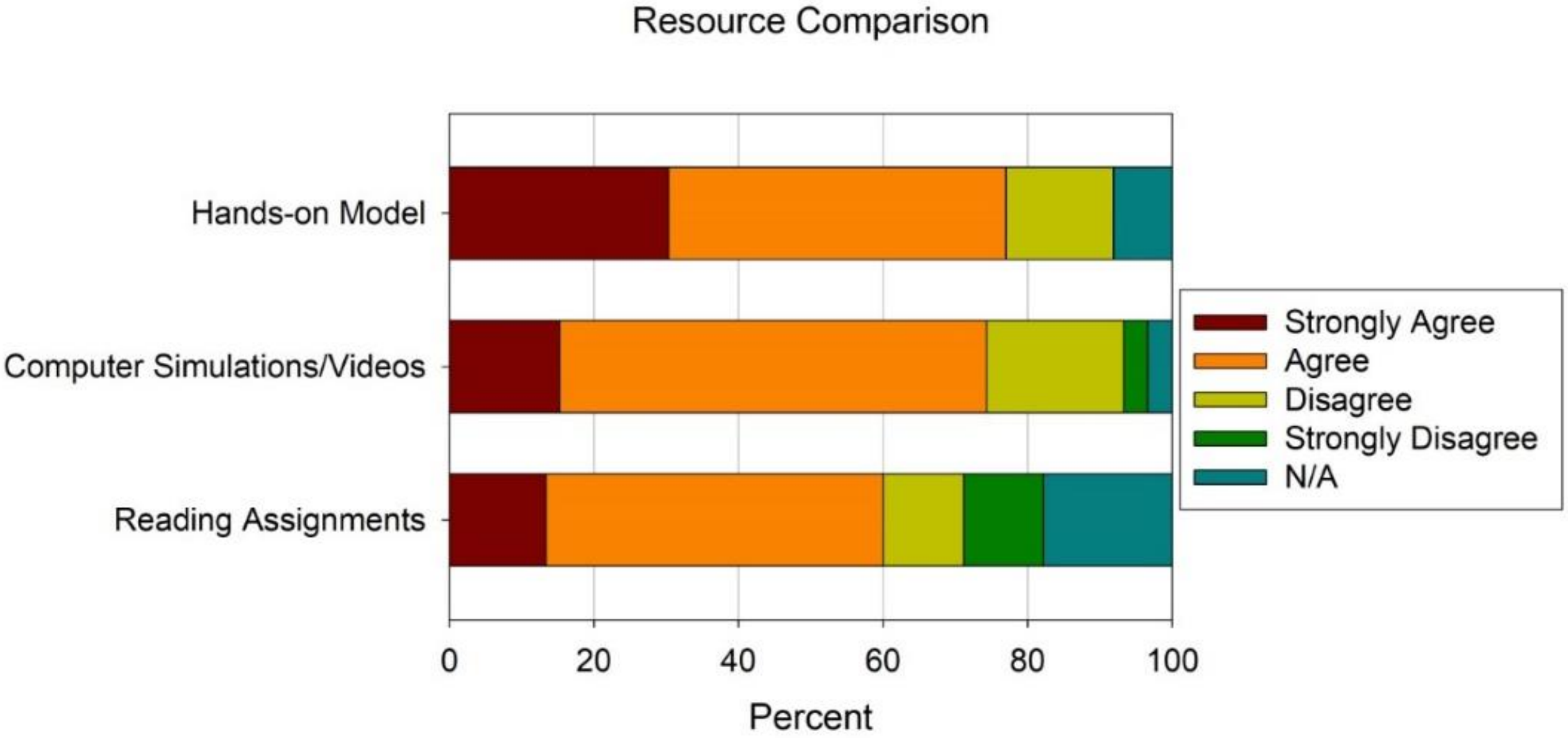
Molecular Visualization Assessment



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

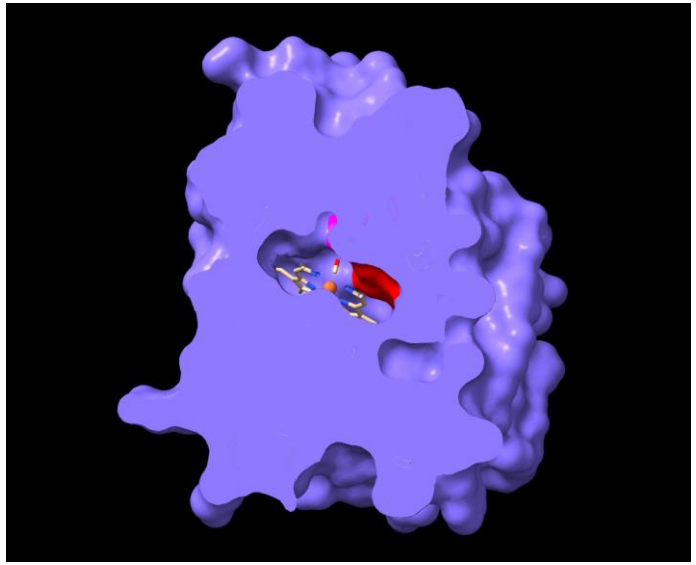


Figure Credit: Jana Villemain

Molecular CaseNet

SCIENCE ADVANCES | RESEARCH ARTICLE

NEUROSCIENCE

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

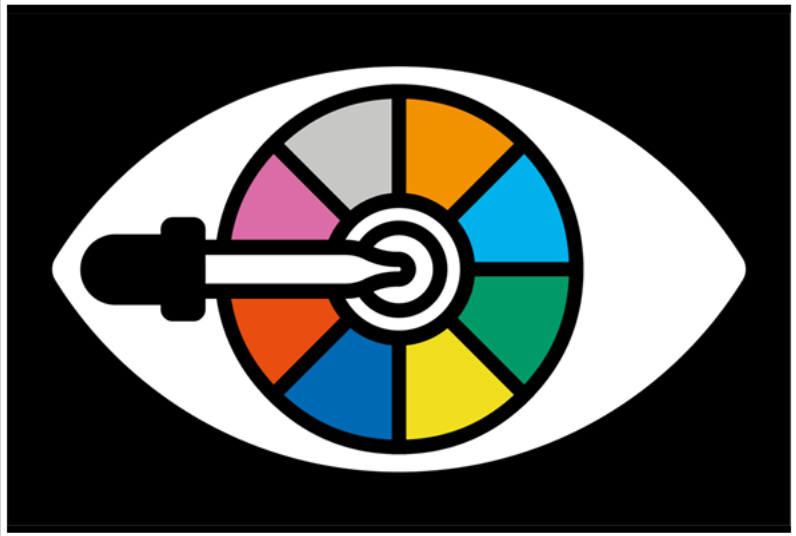


ILLUSTRATION BY THE PROJECT TWINS

FIXING FIGURES FOR COLOUR BLINDNESS

Images can be made more accessible by choosing hues, shapes and textures carefully. **By Alla Katsnelson**

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.

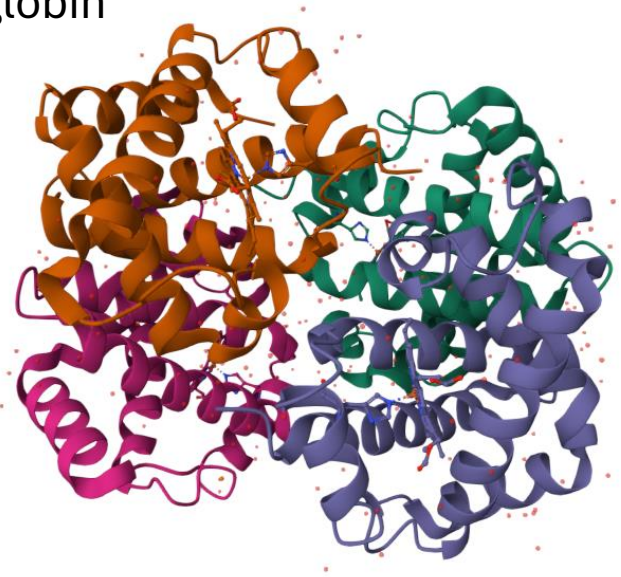
- **Go grey.** Check your figure in greyscale, or by completely desaturating it.

- **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.

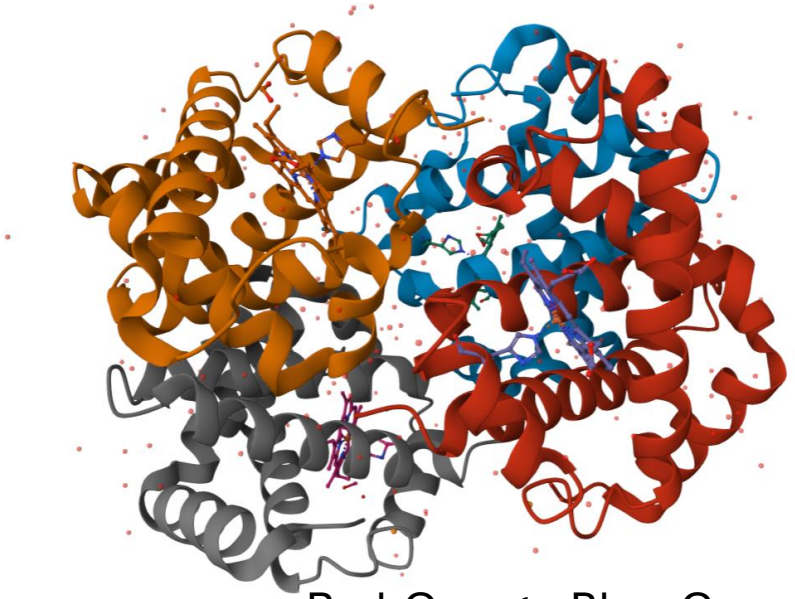
- **Think bigger.** Use features such as shapes and line textures to disambiguate colour.

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

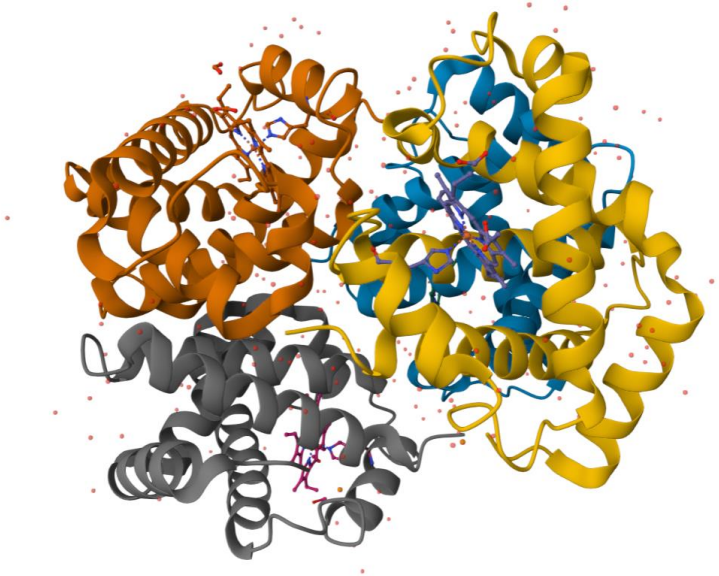
4HHB - Hemoglobin



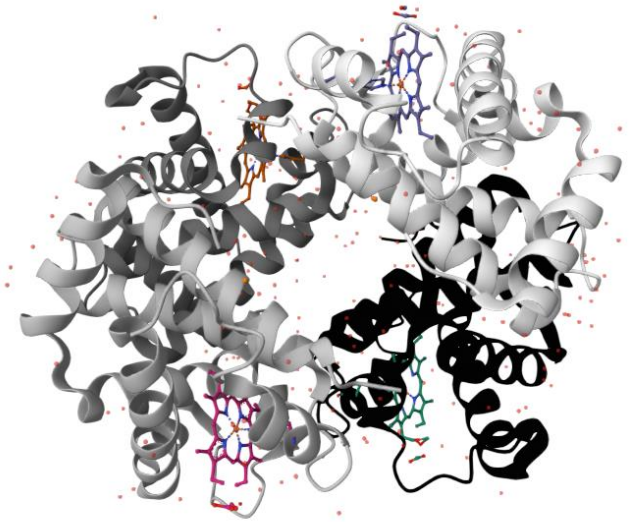
Default Colors



Red-Orange-Blue-Gray



Yellow-Orange-Blue-Gray

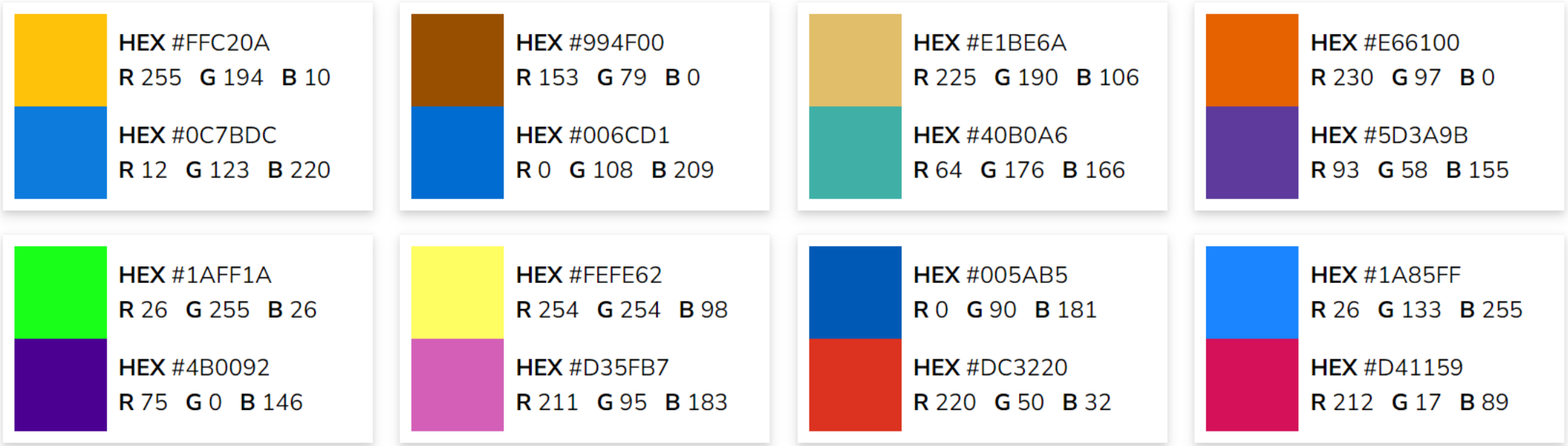


Gray Scale

Coloring for Colorblindness

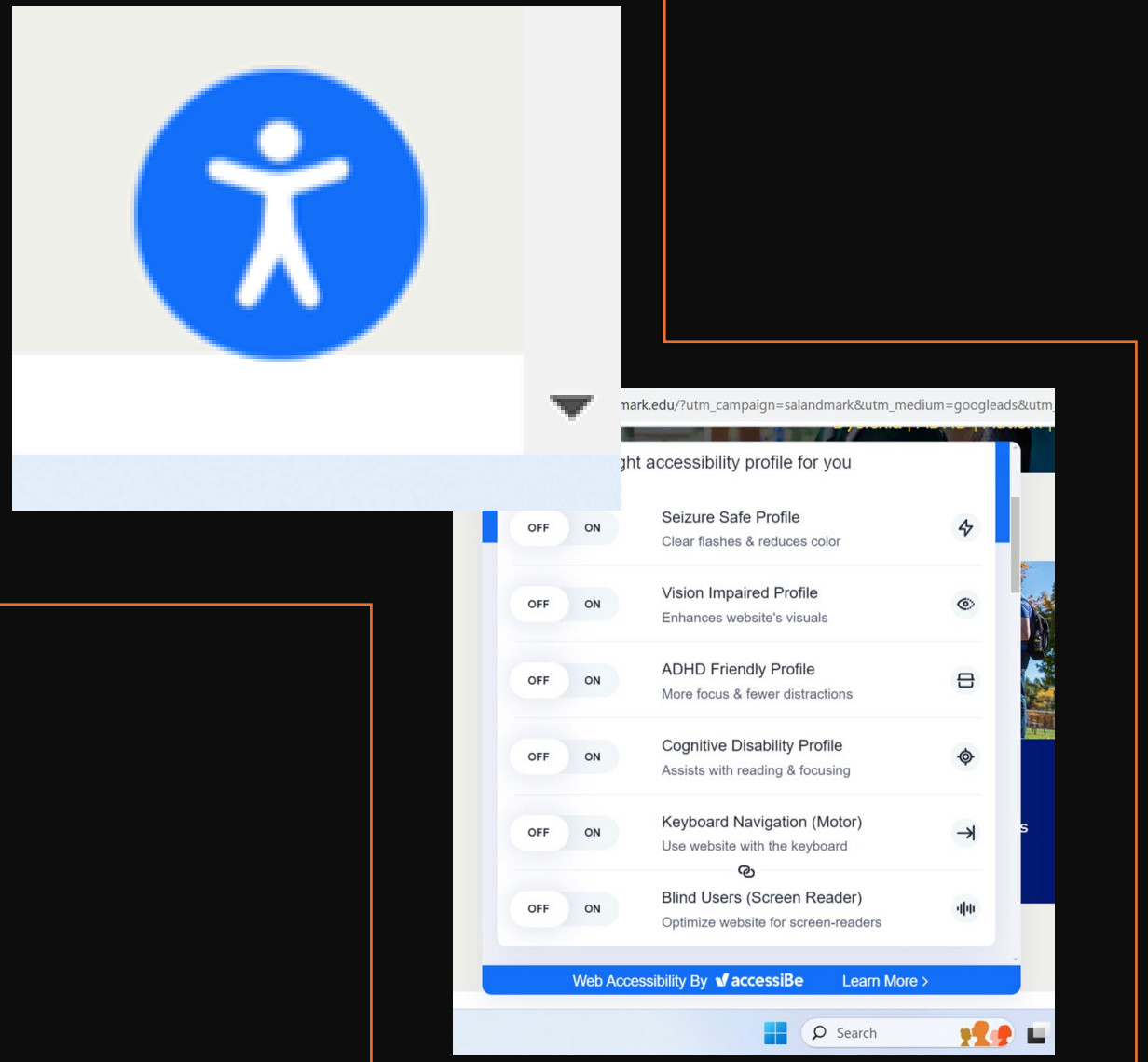
Accessible palettes

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.

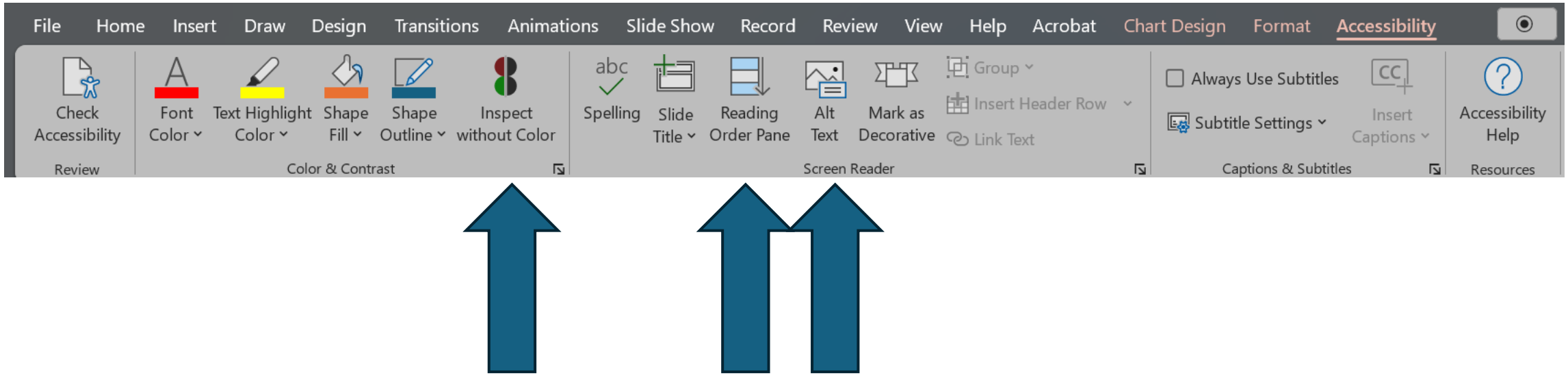


https://davidmathlogic.com/colorblind/

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?*

Alt Text for Different Types of Images

Decorative Icon »

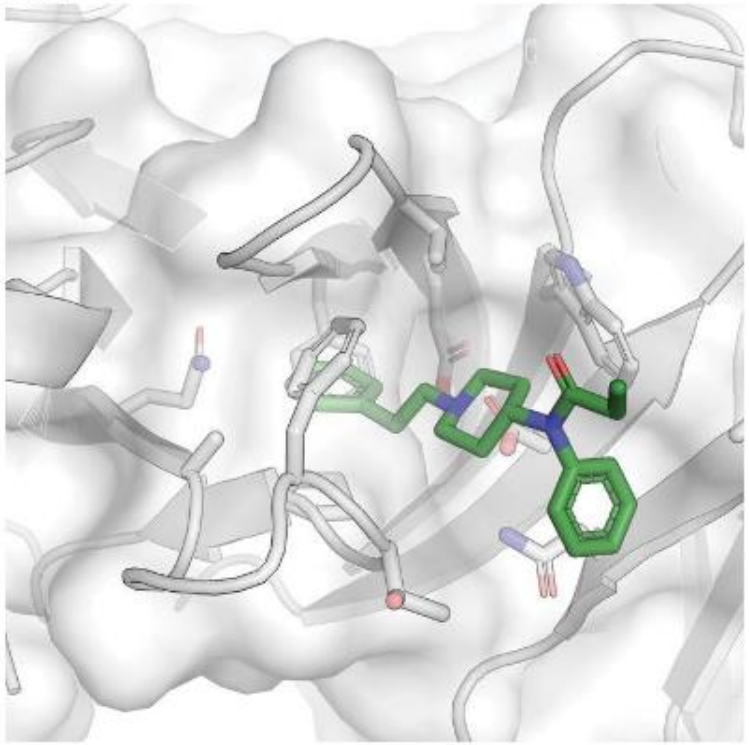
You can mark this image as decorative or leave the alt attribute null.

It doesn't contribute any useful information to the page.

A Group of Students

Alt Text: Four students pose on the shady horseshoe, with the two students in the front throwing their hands up.

Use:



A crystal structure of the new antibody shows how fentanyl fits into its binding pocket
Kim Janda/C&EN

The alt text for this drawing describes what it looks like, while the caption provides editorial comment (C&EN, Aug. 7, 2023).

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."

ACS Inclusivity Guide: Accessibility

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

ISLAND 2023

Inclusion in Science Learning a New Direction:
A Conference on Disability and STEM

Journal of Science Education FOR STUDENTS WITH DISABILITIES

LANDMARK COLLEGE
INSTITUTE FOR RESEARCH AND TRAINING

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