ACCESSIBLE EDUCATIONAL MATERIALS

FOR

MATH AND SCIENCE

SHELBY KAPPLER

WYOMING AEM CLEARINGHOUSE

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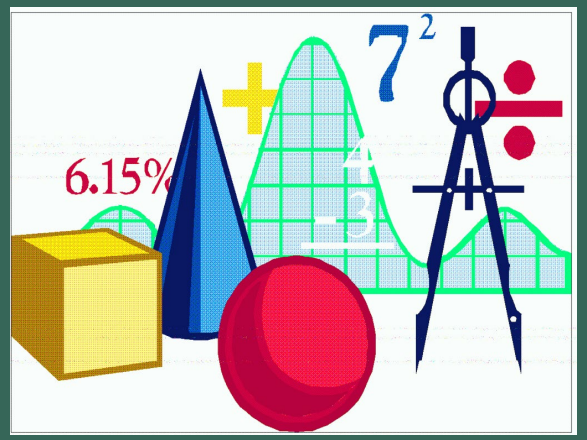


WYOMING
ACCESSIBLE
EDUCATIONAL
MATERIALS

LEARNING OBJECTIVES

- Name the 3 principles of Universal Design for Learning
- Identify at least 4 considerations for teaching math and science to students with print disabilities
- Describe at least 3 strategies, devices, or tools that can make math and science more accessible for students with print disabilities

PRINT DISABILITIES

Visual Impairment/Blindness

- Student has limited or no vision
- May have difficulty with close- up and/or distance viewing, light, color, depth perception
- Example: Student might have trouble seeing teacher demonstrate science experiment

Learning Difficulty

- Student may have difficulty focusing, reading letters or numbers, processing auditory or visual information
- Example: Student might have trouble comprehending verbal classroom instructions

Physical Impairment

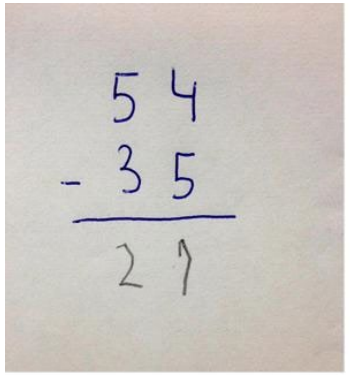
- Student may have difficulty with gross or fine motor skills, reaching, lifting, holding, isolating fingers, coordinating movement
- Example: Student might have trouble using calculator with small buttons

WHY DOES IT MATTER?

- Students with print disabilities are underrepresented in Science, Technology, Engineering, and Math (STEM)
  - 13.4% of US population between 18 and 44 years has a disability
  - 10% of STEM undergraduate students have a disability
  - 6% of STEM graduate students have a disability

  (Source: University of Delaware)

- ALL students should be given equitable opportunity to participate in their learning
- Without support, students may not gain self-confidence or self advocacy skills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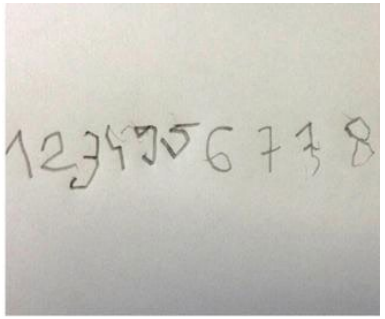
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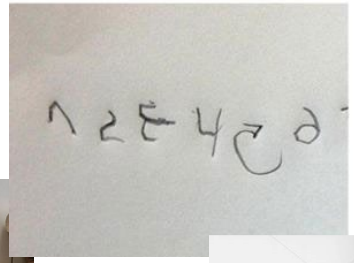

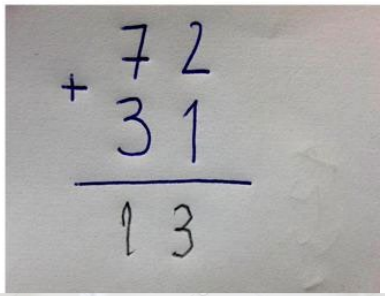
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CHLORIC ACID
1 M
HCl
Irritant
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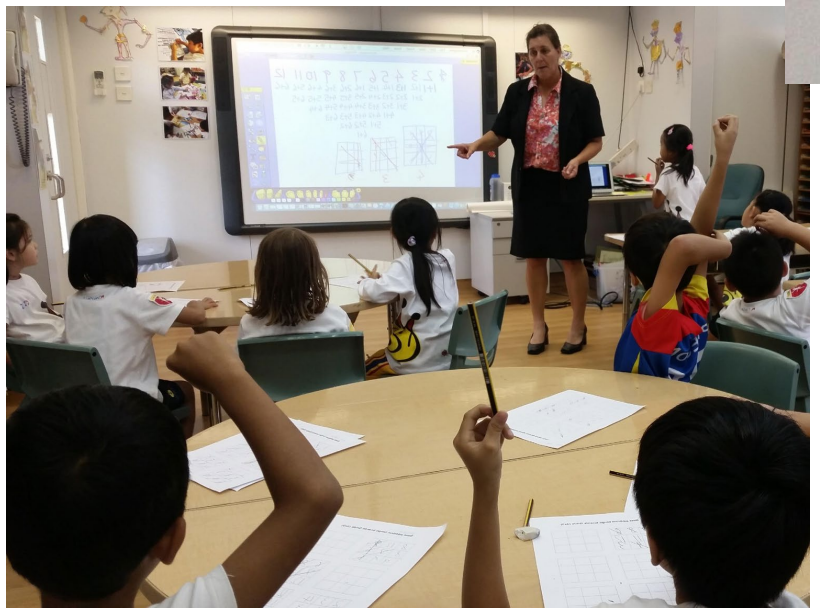
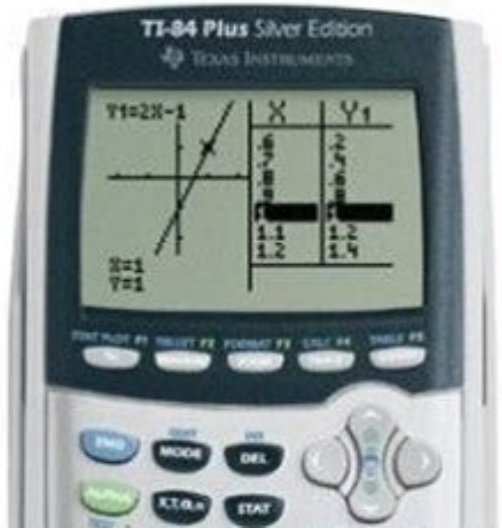



TI-84 Plus Silver Edition
Texas Instruments
Y1=2X-1
X
Y1
MODE
DEL
STAT

UNIVERSAL DESIGN FOR LEARNING

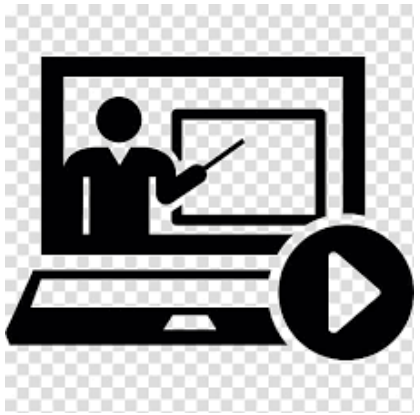
Offer multiple means of:

Engagement

- Recruiting Interest
- Sustaining Effort and Persistence
- Self Regulation

Representation

- Perception
- Language and Symbols
- Comprehension



Action and Expression

- Physical Action
- Expression and Communication
- Executive Function

TIPS FOR ACCESSIBLE TEACHING

Classroom

- Choose course materials early to ensure enough time to find or produce in alternate formats
- Offer assignments and instructions in multiple/alternate formats (braille, large print, audio, digital)
- Face the class when speaking. Repeat instructions, important information and discussion questions
- Write key phrases and lecture outlines on the board or projector
- Allow extra time for students to process information or questions

Laboratory

- Give students individual tours of the lab and address any safety concerns
- Consider assigning group lab projects in which all students contribute according to their abilities
- Arrange equipment so it can be easily accessed by all students
- Offer written and verbal lab instructions

ACCESSIBLE TEACHING TIPS CONTINUED

Field Trips

- Consult with the student on how they might best be able to participate in a field trip
- Do not automatically dismiss a student from a field trip or suggest an alternative
- Consider accessibility needs in requests for field trip vehicle reservations, tours, presentations, etc.

ENGAGING STUDENTS WITH PRINT DISABILITIES

- Dim the lights when working on a projector to minimize eye strain and potential distractions.
- Remember that some environmental factors, such as air conditioners, fans, or buzzing lights, can be distracting to some students.
- Being called on in class can be very disorienting and embarrassing for some students with specific learning disabilities. Let them know ahead of time that you are going to be asking them a question in front of the group, which allows them to collect their thoughts.
- Offer students hard copies of your lecture notes and outlines so they can follow along and add their own notes.
- Keep oral instructions logical and to the point. The teacher must keep on task too!
- When assigning homework, give students several days to work, develop questions, and process feedback.

THE FOUR-STEP ACCOMMODATION MODEL

- Step 1: What does the task or assignment require?
- Step 2: What physical, sensory, and cognitive skills are needed?
- Step 3: What components of the task require accommodation?
- Step 4: What accommodation options exist?

MATH

CHALLENGES

- Math expressions and equations are often not readable, or read incorrectly, by screen readers
- Math expressions use very specific language
- Some types of math involve abstract or highly conceptual thinking

$$f_1(x) = q_1,$$

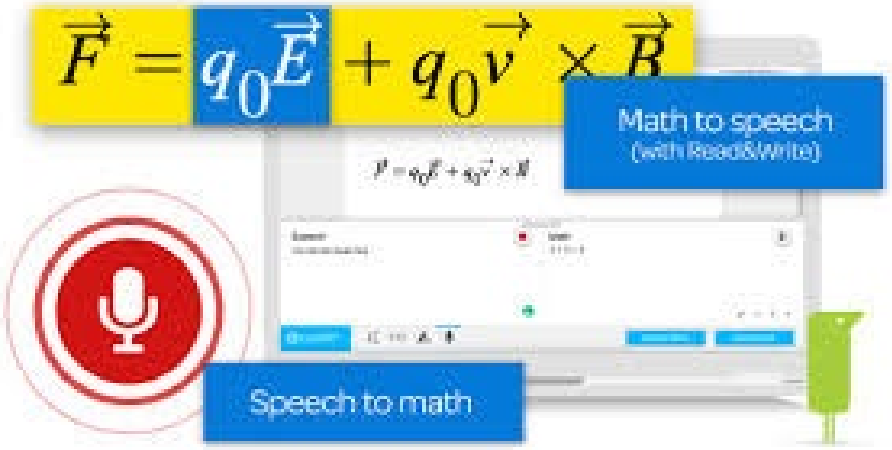
$$f_n(x) = \frac{(f_{n-1}(p_n) - q_n)\prod_{a=1}^{n-1}(x - p_a)}{\prod_{a=1}^{n-1}(p_n - p_a)},$$

$$D(x) = \sum_{a=1}^{z} f_a(x)$$

$$\{n | n \in \mathbb{N}, 1 < n \leq z\}$$

MATH FOR STUDENTS WITH VISUAL IMPAIRMENTS OR BLINDNESS

- Consider seating arrangement
- Clearly describe what is being written on chalkboard/dry erase board
- Consider using calculators with large text, large buttons, high contrast, and/or talking or voiceover features
- Present graphs in tactile format
- Try a program like EquatIO
  - Math to speech
  - Can be integrated with Read&Write and Browsealoud for text-to-speech



MATH FOR STUDENTS WITH LEARNING DISABILITIES (E.G., DYSLEXIA, DYSCALCULIA)

- Use visual and auditory examples
- Give extra time for processing instructions and completing tasks
- Consider seating struggling students near students with strong math skills
- Provide supervised practice (“practice makes permanent”)
- Avoid memory overload
- Review difficult skills
- Use uncluttered worksheets
- Use graph paper to keep numbers in line
- Use real-life situations that make problems applicable to daily life

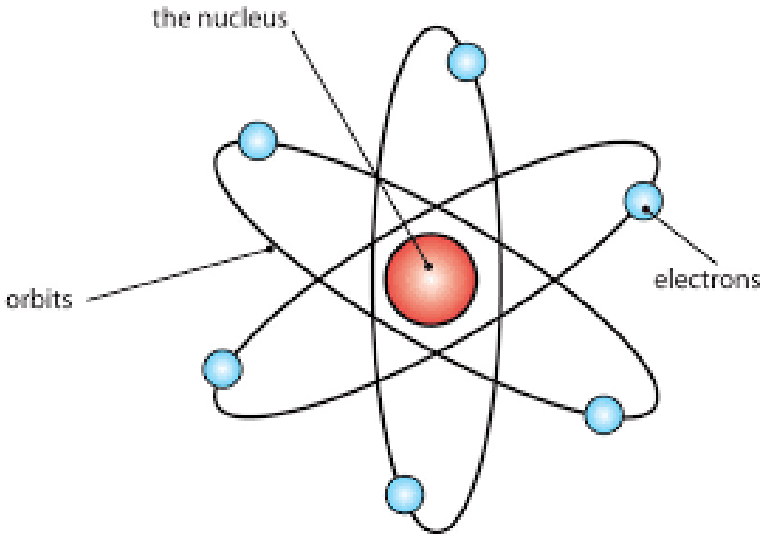
MATH FOR STUDENTS WITH PHYSICAL IMPAIRMENTS

- Consider seating and positioning
  - Supportive seating
  - Position student close to materials
  - Slant board may be beneficial
- Make manipulatives larger and/or use velcro
- Try enlarged worksheets/tests/graph paper
- Use large-button calculators
- EquatIO
  - Speech to math (multiple means of expression)

SCIENCE

CHALLENGES

- Some science content may be difficult to conceptualize
- Most experiments are likely to require accommodation

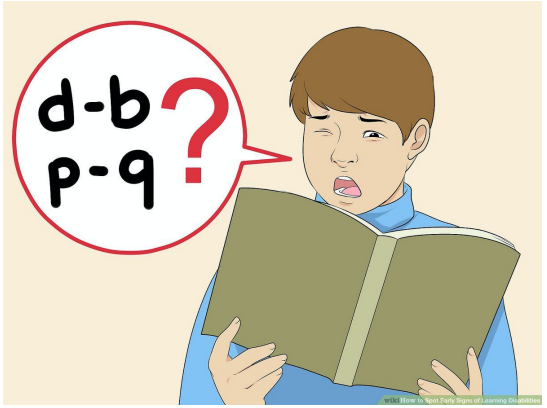


SCIENCE FOR STUDENTS WITH VISUAL IMPAIRMENTS OR BLINDNESS

- Consider seating arrangement and lab layout for demonstrations as well as safety purposes
- Orally describe any demonstrations
- Turn on audio descriptions when available for movies or videos
- Connect lab equipment to a large TV monitor when possible
- Use adaptive lab equipment with audio output or braille, large print, or tactile markings
- Label lab materials in large print or braille
- Provide auditory lab warning signals
- Consider providing a lab partner

SCIENCE FOR STUDENTS WITH LEARNING DISABILITIES

- Provide audio or digital copies of materials
- Incorporate visual, tactile, and oral components into instruction
- Give extra time for processing instructions and completing tasks
- Turn on closed captioning when available for movies or videos
- Seat students away from distractions, such as windows



SCIENCE FOR STUDENTS WITH PHYSICAL IMPAIRMENTS

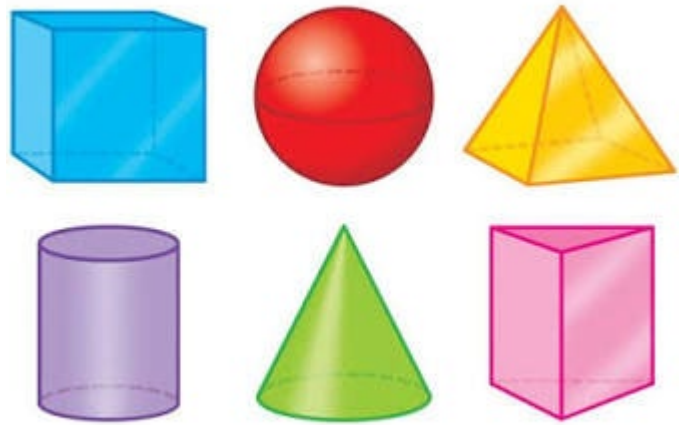
- Make sure student can see demonstrations from a seated position
- Ensure student has access to an accessible workstation
- Place lab materials within reach from a sitting position
- Provide a lab assistant or scribe
- Consider group lab assignments
- Use computer-controlled lab equipment or alternative input devices

ADDITIONAL CONSIDERATIONS

- A Teacher of the Visually Impaired (TVI) may be able to provide additional resources and help obtain accessible materials
- The IEP team and support staff can provide insight on how to work with a particular student
- An Occupational Therapist (OT) or Physical Therapist (PT) may provide guidance on seating and positioning, physical and motor skills, and adaptive tools
- Ensure the student is included in class discussions and projects
- Ask the student what is best for them
- Allow and encourage the student to use assistive technology
- Be creative and flexible when it comes to finding solutions

DEVICES FOR ACCESSIBLE MATH AND SCIENCE

DIY MATH & SCIENCE “HACKS”



- For geometric shapes, use 3-D objects.
- Use a 3-D printer to create custom objects.
- Use a pegboard with golf tees and rubber bands to draw shapes or develop spatial awareness.
- Make graphs tactile by using glue guns or fabric paint.
- Use staples on a ruler to label increments.
- Make a tactile graduated cylinder using cork or styrofoam.

“HACKS” CONTINUED

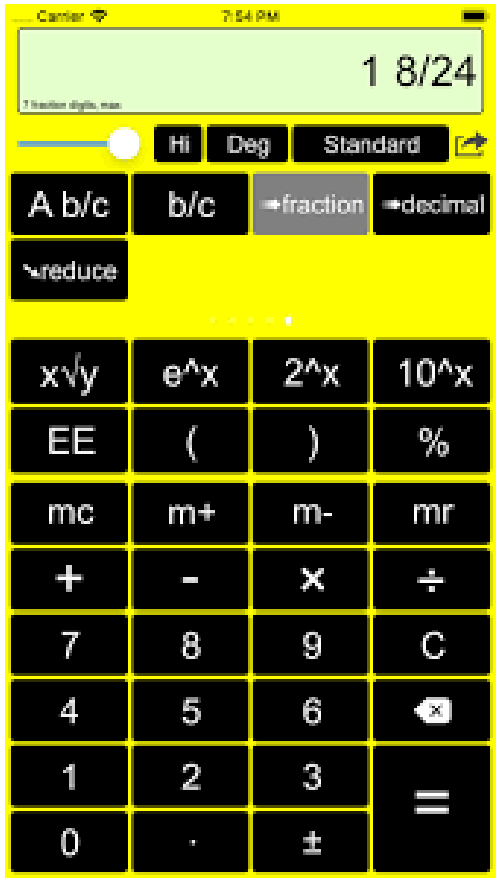
- Make a syringe tactile by cutting notches in the plunger at 5-mL increments.
- Make a triple beam balance tactile by filing deep notches for each gram increment. Add glue drops on either side of the balance line so that the student will know when the weights are balanced.
- Identify increments of temperature on a stove with fabric paint or sticker bump dots.
- Use different textures like sandpaper or yarn to identify drawers, cabinets, and equipment areas.
- Make models out of clay, plaster of paris, or papier-mâché.

HANDS-FREE CALCULATOR- NEWTON

- iOS app
- Free
- Use voice or keyboard to input calculations
- Beneficial for student with motor impairments- calculator buttons are small!
- User can export calculations
- Last updated in 2015

TALKING CALCULATOR

- iOS app
- $2
- Switch between high and low contrast
- Compatible with VoiceOver
- Record a new voice in 5 minutes!
- Calculations are recorded and can be viewed or emailed
- Talking Scientific Calculator
- Talking Statistics Calculator



Explore graphs using either spoken announcements or audio and haptic (vibrating) feedback. Moving along the graph from left to right shifts the tone from the left to the right stereo channel. Tones raise and lower to follow graph coordinates. As the graph moves below the x-axis where the y-coordinates are negative, white noise is added to the tone. Haptic feedback is provided for negative y-coordinates, axes crossings, and tick marks.

ORION TI -84 PLUS TALKING GRAPHING CALCULATOR

LARGE PRINT AND BRAILLE TACTILE RULER AND PROTRACTOR

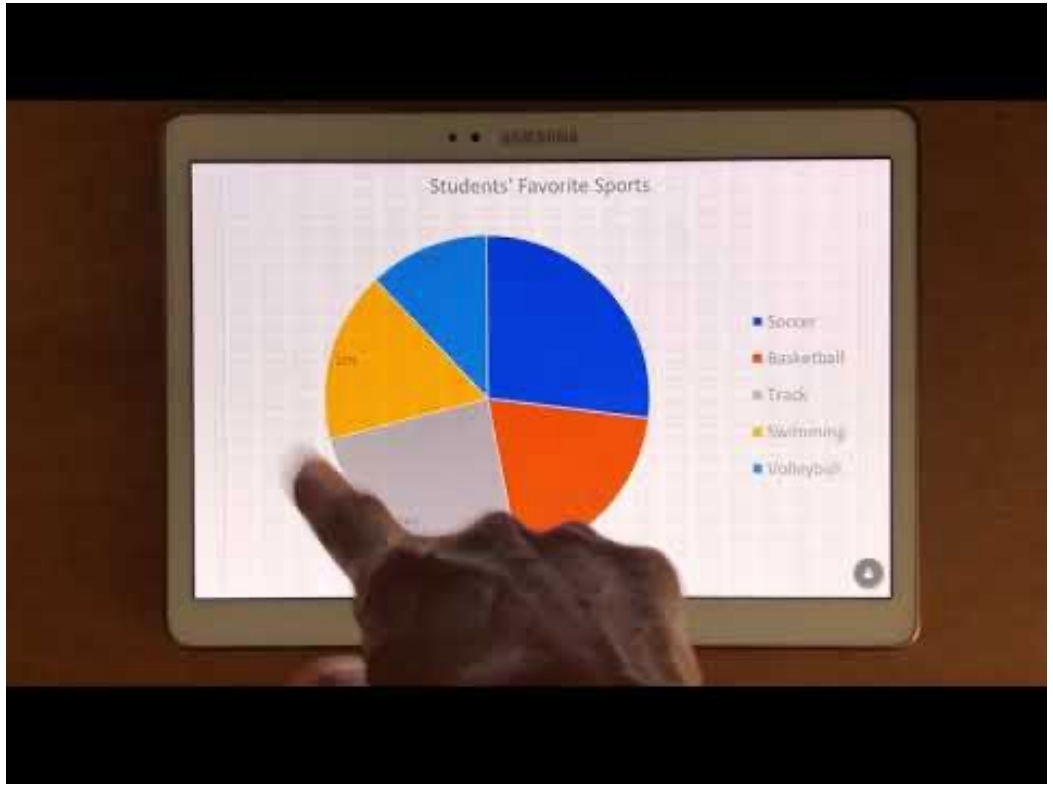
PIAF is a machine that makes raised line drawings on special paper, called capsule or swell paper. Users can draw, print or photocopy pictures onto the swell paper and pass it through the PIAF. The heat of the PIAF causes the lines to swell and then the drawing can be read with the fingers. It is ideal for people who are blind and vision impaired. PIAF is being used in a variety of educational, employment and personal settings.

PICTURES IN A FLASH (PIAF)

ROCKETBOOK COLLABORATION BUNDLE

The Rocketbook Collaboration bundle contains a 10”x15” whiteboard and a reusable notebook that can both be scanned with the Rocketbook app and turned into digital content. The Rocketbook Beacons are used as cornerpieces to turn any square or rectangular surface into a digital display, using SnapCast technology.

This app offers students visual, tactile, and auditory representations of graphics. Students can navigate across the touchscreen to explore images, diagrams, graphs, tables, or charts, while keeping their place with varying tones and vibrations.



VITAL DIGITAL TACTILE GRAPHICS

Includes:

•100" print/braille meter tape

•Modified 100 ml and 1000 ml plastic beaker

•(2) graduated cylinders 50 ml and (2) 100 ml w/ large print and braille scale floats

•Histogram board

•Instructions in braille

•Balance

•Funnel stand

•Mass set w/20-, 10-, 5- g pieces

•Mass set with one hundred 1-g pieces

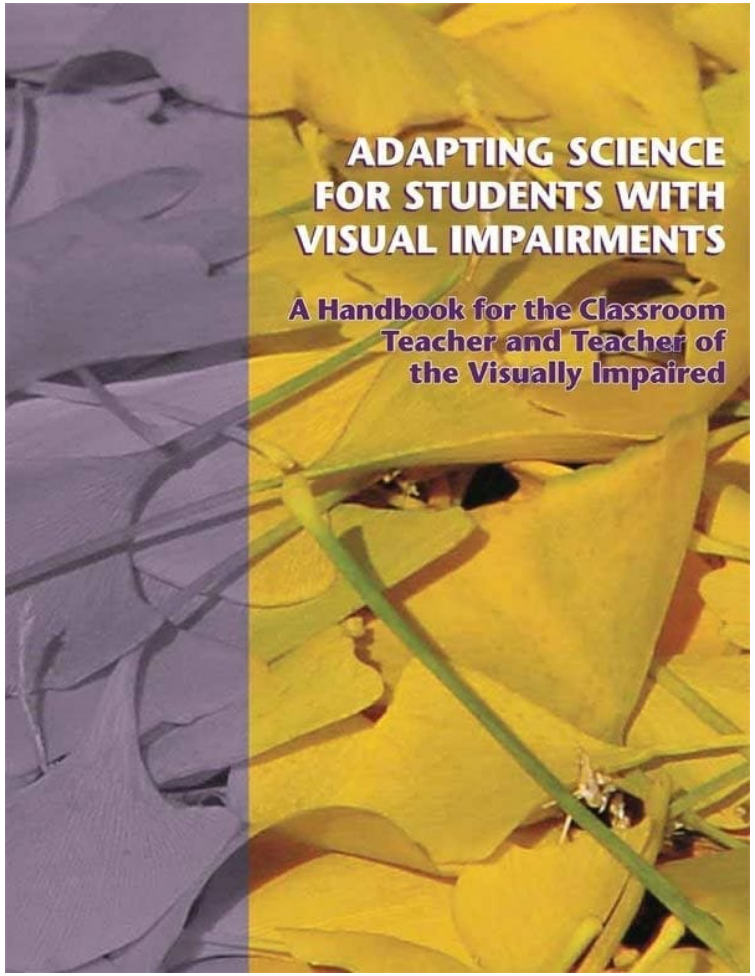
•Talking digital thermometer

•(2) tray liners

•50 ml syringe with stop

•(4) 9 oz. plastic cups

ADAPTED SCIENCE MATERIALS KIT



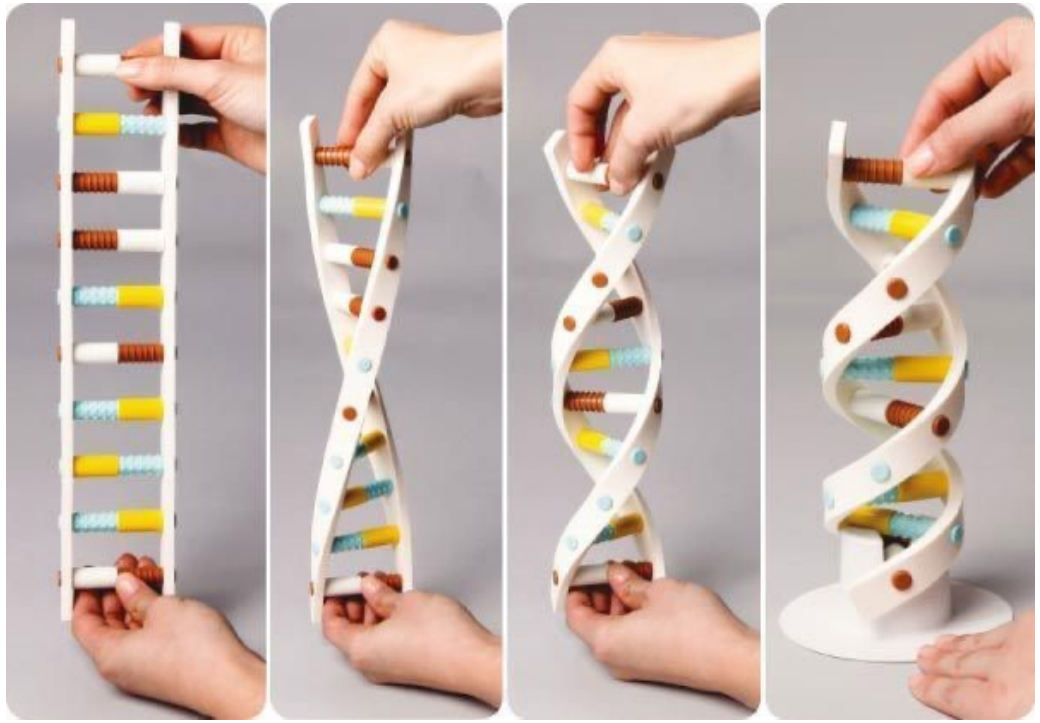
This handbook provides considerations and resources for science teachers working with students with visual impairments or blindness. The book includes checklists and adaptations, and is suitable for those with limited science background or who have not worked with students with visual impairments.

ADAPTING SCIENCE FOR STUDENTS WITH VISUAL IMPAIRMENTS GUIDE

Connect this small, portable microscope wirelessly to any mobile device, or use a USB cable to connect to a computer or monitor. Magnifies 50x to 1000x, and includes adjustable brightness LED lights for enhanced clarity.

PANCELLENT WIRELESS DIGITAL MICROSCOPE

These products identify the amino acids that make up DNA and RNA by color and texture. The user can feel or see how the different molecules interact.



DNA TWIST MODEL AND DNA/RNA KIT

RESOURCES

- American Printing House for the Blind (APH)
  - May use Federal Quota Funds to purchase materials
  - https://www.aph.org
- Vision Outreach Services, Wyoming Department of Education
  - https://edu.wyoming.gov/in-the-classroom/special-programs/vision-outreach-services/
- UW Wyrkshop- Makerspace
  - https://www.wyrkshop.org
- https://www.thingiverse.com

RESOURCES

Wyoming Accessible Educational Materials (AEM) Clearinghouse

307-766-5770

aem@uwyo.edu

www.uwyo.edu/wind/aem

WYOMING ACCESSIBLE EDUCATIONAL MATERIALS

Wyoming Assistive Technology Resources (WATR)

307-766-6187

watr@uwyo.edu

www.uwyo.edu/wind/watr

WATR Wyoming Assistive Technology Resources

Device Database

https://wy.at4all.com

REFERENCES

DO-IT, & Burgstahler, S. (2009). *Making Math, Science, and Technology Instruction Accessible to Students with Disabilities*. Making Math, Science, and Technology Instruction Accessible to Students with Disabilities. https://www.washington.edu/doit/book/export/html/527

UDL: The UDL Guidelines. (2020, October 6). CAST. http://udlguidelines.cast.org

Statistics and Facts about Students with Disabilities | Science & Engineering Leadership Initiative (SELI). (2020). University of Delaware. https://sites.udel.edu/seli-ud/facts/

QUESTIONS?