Strategies for STEM Success!

WORKSHOP
Technological Education Center for Deaf & Hard-of-Hearing Students

Serves as a **resource** for:

- high schools & community colleges that educate D/HH students in STEM-related programs
- employers hiring D/HH individuals

DeafTEC has **affiliate partnerships** to improve access to technological education and employment for D/HH individuals.
Importance of STEM

- Deaf and hard-of-hearing workers in STEM careers earn 34.00% more than deaf workers in non-STEM
Increased Participation in the STEM Labor Force

Deaf/hh High School Grads

- 44% not participating
- Non-STEM: 55.00%
- STEM: 85.19%

Deaf/hh College Grads

- 7.8% not participating
- 14.81% not participating
- Non-STEM: 7.8%
- STEM: 74.78%
- Non-STEM: 14.81%
- STEM: 92.20%

Reference: U.S. Census Bureau American Community Survey.
Retrieved from dataferrett.census.gov
Deaf Employees Earn More in STEM Jobs

- **High School**: $47,804 (28%)
  - Non-STEM: $37,357
  - STEM: $47,804

- **Associate Degree**: $63,427 (39%)
  - Non-STEM: $45,470
  - STEM: $63,427

- **Bachelor's Degree**: $87,812 (37%)
  - Non-STEM: $64,301
  - STEM: $87,812

- **Master's Degree**: $102,323 (21%)
  - Non-STEM: $84,818
  - STEM: $102,323

- **PhD/EdD**: $148,140 (55%)
  - Non-STEM: $95,490
  - STEM: $148,140
Lower Unemployment Rates in STEM

Deaf/hh High School Grads

- Non-STEM: 9.69%
- STEM: 5.11%

Deaf/hh College Grads

- Non-STEM: 6.53%
- STEM: 5.02%

Technical vocabulary and new definitions for common words can be difficult for DHH students.

For example, “significant”

<table>
<thead>
<tr>
<th>Context</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common</td>
<td>Important</td>
</tr>
<tr>
<td>Math</td>
<td>Significant figures</td>
</tr>
<tr>
<td>Statistics</td>
<td>Data unlikely to occur by chance</td>
</tr>
</tbody>
</table>
Activity #1

Experience a classroom lecture from the perspective of a student who struggles with language.

You are a deaf student who relies on accommodations – in this case captioning – to access what the teacher is saying.
Activity #1

- You are a student in an art history course.
- You will watch the video lecture, taking notes to prepare for the quiz that will follow.

https://www.deaftec.org/perils-lecturing
Debrief

• How did you feel during this lecture?

• What was difficult?

• What would you do differently?
Ten Skills You Need to Land a STEM Job

- Critical Thinking*
- Analytical Skills*
- Problem Solving*
- Innovation*
- Collaboration*

- Communication*
- Customer Orientation
- Adaptability
- Social Responsibility
- Balance

Mathematical Literacy and Citizenship
Number Sense

A Tale of Two Burgers

1/4 lb. burger (1972) vs. 1/3 lb. burger (1980)...

Different weights, same price, only one was successful.

Note: Blind test tasters even claimed A & W’s 1/3 lb. burger tasted better.
• Global Citizenship

• In early 2014, Oxfam found that the world’s 85 richest people owned the same wealth as the poorest half of the world’s population.

• By January 2015, this number had fallen to 80. By the time you read this, it is likely to have fallen further still.
Number Sense

• Global Citizenship

What story about inequality do these statistics tell? Are the numbers reliable? How was the research carried out? Does everyone agree with these figures?

Learners can develop their mathematical understanding both in making sense of such data and by investigating its context and validity.
GROWTH MINDSET
Activity #2: Do This – 5 Minutes

READ CAREFULLY

BE HONEST

WRITE TOTALS

TURN OVER
Carol Dweck - Professor of Psychology at Stanford University.

Especially applies to mathematics learning.
A Few More Points About This....

- Jo Boaler – professor of Mathematics Education at Stanford University
- Youcubed.org
Impact of Teacher Mindset

• Educators with a fixed mindset about math ability were more likely to judge students as having low potential than their growth-minded counterparts.
Impact of Teacher Mindset

• Educators with a fixed mindset were more likely to comfort students about their perceived low math abilities and apply "nice" strategies.
So What Can You Do?

- **Give feedback that focuses on process**
  - Praise things like effort, challenge seeking, persistence, good strategies
  - Don’t praise personal traits or abilities ("smartness").
THE POWER OF

... YET
...YET
THE MOST POWERFUL ADDITION

I don't get it + yet = Optimism

I can't do this + yet = Perseverance

I can't do math + yet = Growth Mindset

THESE TRAITS ADD UP TO HAVING GRIT!
Ways of Thinking

Count the number of dots without individually counting.

25
Communication is Key

Planning

Clarity

Flexibility
Planning

- Consider slowing the pace at which new material is presented
- Identify main point(s) for the lesson
  - Focus on the main point(s)
- Find or create visual representations of concepts
- Carefully consider English words and grammar
- What signs or gestures might support learning this concept?
Room Set Up

Can students see...
• what the teacher is presenting?
• all the other students participating in the discussion?
Clarity

- Refrain from using unnecessary complex terminology when not a part of the learning objective being assessed.
  - Example: Instead of "cardiologist", use "heart doctor"

- Be clear and concise when teaching.
  - Avoid using "this" or "that"
Drawings: You don’t have to say it

- Use visual representations of concepts wherever possible
- Good reference for interpreters, students remember better
- Make use of color!

Event A: student is “wearing glasses”
= \{ Heidi, Charlie \}
**Step 1.**

<table>
<thead>
<tr>
<th>[4x + 5x + 1]</th>
<th>[18 + 2 - 1]</th>
<th>Combine “like” terms that are on the same side</th>
</tr>
</thead>
<tbody>
<tr>
<td>[9x + 1]</td>
<td>[19]</td>
<td>→ On the left side, combine the x terms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>→ On the right side, combine the # terms</td>
</tr>
</tbody>
</table>

**Step 2.**

<table>
<thead>
<tr>
<th>[9x + 1]</th>
<th>[19]</th>
<th>Combine “like” terms that are on different sides</th>
</tr>
</thead>
<tbody>
<tr>
<td>[-1]</td>
<td>[-1]</td>
<td>→ Combine +1 on the left with 19 on the right.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>→ How? Add the opposite of +1 to each side</td>
</tr>
</tbody>
</table>

**Step 3.**

<table>
<thead>
<tr>
<th>[9x]</th>
<th>[18]</th>
<th>“Isolate” x</th>
</tr>
</thead>
<tbody>
<tr>
<td>[9]</td>
<td>[9]</td>
<td>→ Divide by 9 on both sides</td>
</tr>
<tr>
<td>[x]</td>
<td>[2]</td>
<td></td>
</tr>
</tbody>
</table>

**Use a visual approach to show and explain.**
• Memory Tricks (PEMDAS, FOIL, SOH CAH TOA, etc.)
  ◦ Shorthand makes it easier to remember
  ◦ Be sure to “spell it out”: PEMDAS
    ◦ Parentheses ( )
    ◦ Exponent ( )³
    ◦ Multiplication 6 x 5
    ◦ Division 10/2
    ◦ Addition 14 + 73
    ◦ Subtraction 101 – 26
  ◦ Beware: Alternate phrases can just add confusion
    ◦ Please Excuse My Dear Aunt Sally (Who is Aunt Sally?)

Discipline-Specific Language
Flexibility - Multiple Methods of Expression

Three-fifths

\[
\frac{3}{5}
\]
Activity #3 - Explain This!

Create a visual explanation for one of these math concepts (or choose one of your own)

➢ Brainstorm visual representations
➢ Consider how use of color could improve understanding
➢ What are the ASL sign(s)?

\[ x + y = 8 \]
\[ x - y = 4 \]

Find the values of \( x \) and \( y \).

Find the values of \( x \) and \( y \).

Metric System

Empirical Rule

What is the length of side \( b \)?
Manage the Cognitive Load

• Visual information
  ◦ Don’t crowd the PowerPoint slides with too much text
  ◦ DHH students rely on eyes – can only look one place at a time
One Input at a Time

- Hearing students can be taking notes and listening at the same time, but often do not process what they are hearing.
- Give students the best chance of “hearing” the message:
  - Be silent while writing on the board.
  - Turn around and **wait** until students have finished writing and their eyes are on the teacher.
  - Then (finally!) the teacher can talk through what is on the board.
Cooperative Learning

- Small teams work together on structured activity
- Widely used teaching and learning strategy
- Requires cooperation and communication
Cooperative Learning

Communication Challenges

Students may:

- Rely on notetaker's notes that are not available until after class.
- Not understand each other's speech / signing
- Not have an interpreter readily available to aid communication within team*
- Prefer direct communication with their peers
Whiteboards
Using Whiteboards for Teamwork

- Assists with communication and participation
- Has Universal Design Potential: Hearing students, ESL students, also benefit
- Is inclusive of students who prefer to participate in a non-vocal way
Many online resources

- Videos (e.g. Khan Academy, Video Math Tutor, teacher-made videos, etc.)

Benefits

- Support “flipped” classroom
- Provide extra help
- Students can work at their own pace
Sum of two numbers is 70. They differ by 11. What are the numbers?

Let $x$ be the larger number.

Let $y$ be the smaller number.

$x + y = 70$

$x - y = 11$

$x = y + 11$

$(y + 11) + y = 70$

tells us all for life


Link to Khan Academy
Issues with Online Resources

- Availability of Captioning
- Inaccurate Captioning
- Place and timing of multiple inputs makes it difficult to follow
Types

- **Real-Time Captioning**
  Typing what is being said in “real time” into a computer that projects the words on a screen. Computer Assisted Real-Time Translation (CART) is often used in educational settings.

- **Open Captioning**
  Always in view on the screen and cannot be turned off by the viewer.

- **Closed Captioning**
  May be in view and can be turned on or off by the viewer.

- More information can be found at [http://deaftec.org/captioning-media](http://deaftec.org/captioning-media)
Why Not Use Gary’s Videos?

Let’s meet Gary and see his list of videos
Benefits to Gary’s Video

- Segmented
- Pace
- Multi-Modal
ASL Math Videos

• Pros? Cons?
• Can you see a use for this in your classroom? How? How not?
• Will this help achieve our goal? How? How Not?
There are considered especially fitting to use in the mathematics education of deaf and hard-of-hearing students specifically for deaf and hard-of-hearing learners while others help with the instruction of deaf mainstream classes. There is a variety of print and online materials, many of which give students access to involving reading, writing, sign language and other means of communication. The intent of these teachers and tutors of deaf/HH students with instructional avenues and ideas that stress problem-solving in mathematics learning.
Math Resources

Math Video Tutorials

- Solving Linear Equations with One Variable
- Solving Linear Equations with Two Variables
- Working with Polynomials
- Exponents
- Working with Radicals
- Quadratic Equations
- Systems of Two Equations
- Teaching Math to Deaf Students
- Using Cooperative Learning Groups

Gary Blatto-Vallee, a math and science instructor at the National Technical Institute for the Deaf, guides you through a variety of mathematical exercises in this DeafTEC video series. All lessons are recorded, signed in ASL, and voiced. See the video below for an introduction to this video series. If you have questions about these videos, contact DeafTEC here.
Math Videos

Solving Linear Equations with One Variable

Lesson Outline

- Solving Linear Equations with One Variable
  - Solving Linear Equations
  - Solving Linear Equations with Fractions
  - Solving Linear Equation with Fractions and Grouping Symbols
  - Practice Problems

- Solving Linear Equations with Two Variables
  - Solving for (x,y) in table
  - Graphing linear equations with ordered pairs (x,y)
  - Plotting points for a linear equation using a table of values
  - Slope on the X and Y plane
  - Using the slope formula
  - Slope-Intercept form of linear equations
  - Slope & Intercept from linear equations
  - Parallel lines
  - Perpendicular lines
  - Practice Problems

- Working with Polynomials
  - Multiplying Polynomials
    - Multiplying Polynomials #1
    - Multiplying Polynomials #2
    - Special Products #1
    - Special Products #2
Solve the system of equations below using the graphing method.

1. \( y = 2x + 1 \)
2. \(-4x + 2y = 10\)
Teaching Math to Deaf Students

Math Word Problems

- Word Problem Analysis Template - form developed by Dawn Kidd. Also available as a PDF.

Miscellaneous Resources

1. VoiceThread: online way for teachers and students to communicate via video or print.

ASL/Math Dictionaries

1. Texas Math Sign Language Dictionary - Texas School for the Deaf
2. Math Signs, by Chris Kurz on YouTube
   - Numbering System
   - Algebra
   - Trigonometry

Print Math Dictionaries

Illustrated Maths Dictionary, by Judith de Klerk.

Math Concept Description in ASL