INTERPRETING ADVANCED MATHEMATICS

$$\langle \phi_{i_1}\phi_{i_2}|H_{\text{int}}|\phi_{i_3}\phi_{i_4}\rangle = \sum_{k=0}^{\infty}\sum_{m_k=-k}^{k}\frac{(k-|m_k|)!}{(k+|m_k|)!}(-1)^{(m_1+|m_1|+m_2+|m_2|+m_3+|m_3|+m_4+|m_4|)/2}$$

$$\times\sqrt{\frac{(2l_1+1)(l_1-|m_1|)!}{(l_1+|m_1|)!}}\sqrt{\frac{(2l_2+1)(l_2-|m_2|)!}{(l_2+|m_2|)!}}$$

$$\times\sqrt{\frac{(2l_3+1)(l_3-|m_3|)!}{(l_3+|m_3|)!}}\sqrt{\frac{(2l_4+1)(l_4-|m_4|)!}{(l_4+|m_4|)!}}$$

$$\times\int_0^{\infty}\int_0^{\infty}R_{n_1,l_1}(r_1)R_{n_2,l_2}(r_2)R_{n_3,l_3}(r_1)R_{n_4,l_4}(r_2)\frac{r_<^k}{r_>^{k+1}}r_1^2r_2^2\mathrm{d}r_1\,\mathrm{d}r_2$$

$$\times\frac{1}{2}\int_0^{\pi}P_{l_1}^{|m_1|}(\cos\theta_1)P_{l_3}^{|m_3|}(\cos\theta_1)P_k^{|m_k|}(\cos\theta_1)\sin\theta_1\,\mathrm{d}\theta_1$$

$$\times\frac{1}{2}\int_0^{\pi}P_{l_2}^{|m_2|}(\cos\theta_2)P_{l_4}^{|m_4|}(\cos\theta_2)P_k^{|m_k|}(\cos\theta_2)\sin\theta_2\mathrm{d}\theta_2$$

$$\times\frac{1}{2\pi}\int_0^{2\pi}\mathrm{e}^{\mathrm{i}(-m_1+m_3+m_k)\phi_1}\mathrm{d}\phi_1\times\frac{1}{2\pi}\int_0^{2\pi}\mathrm{e}^{\mathrm{i}(-m_2+m_4-m_k)\phi_2}\,\mathrm{d}\phi_2.$$

2016 Bryon Rowe

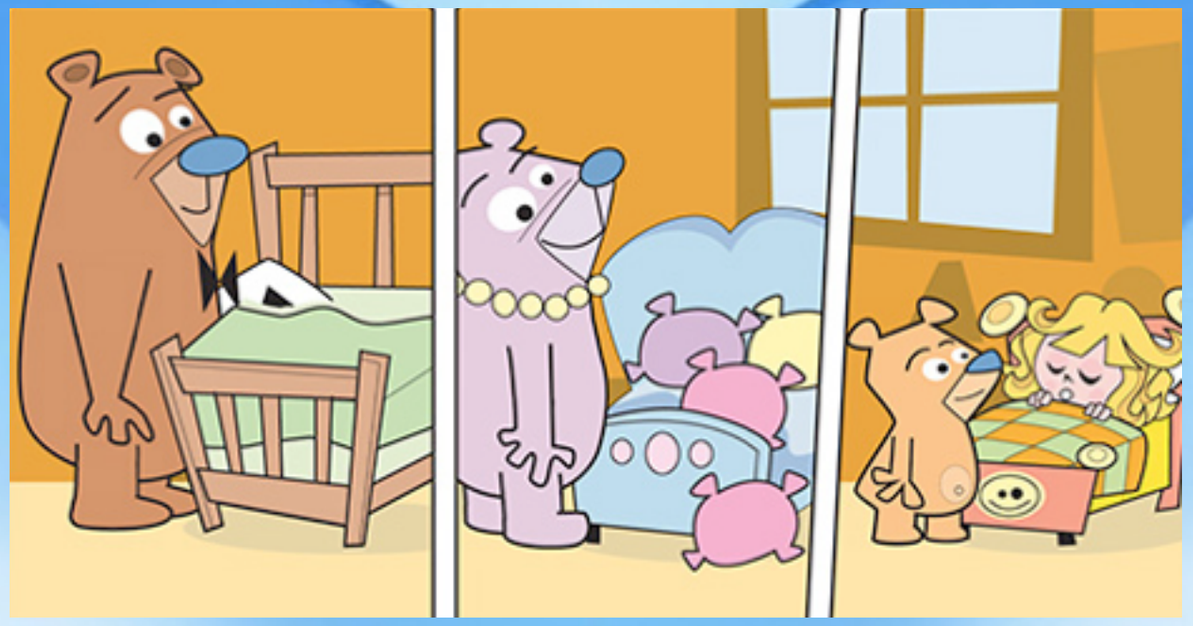
http://bryonrowe.wix.com/interpreter-teacher#!2016-workshops/c23v8

FORMAT & TOPICS

- **Skill requirement perspectives**
- **Mathematics knowledge requirements**
- **ASL knowledge requirements**
- **Linguistic knowledge & skills**
- **Navigating Logistics of this setting**
- **Practice applying concepts**

English

SKILL REQUIREMENT PERSPECTIVES

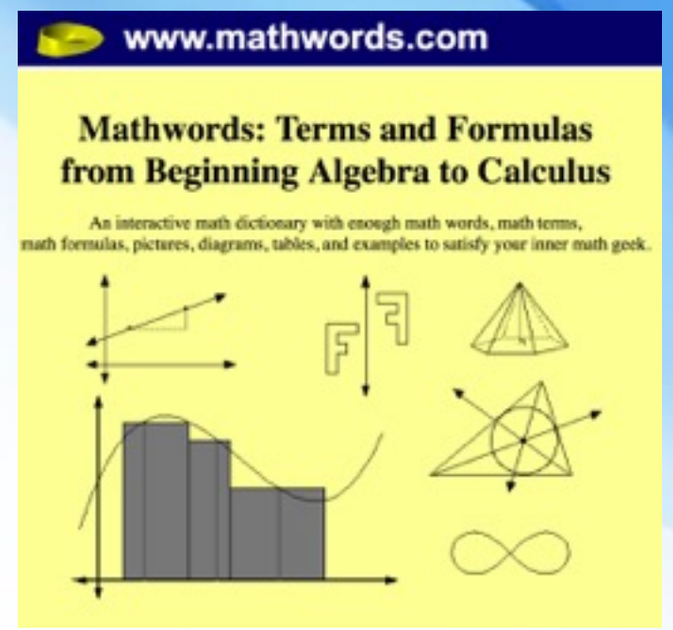


- Must have a degree in Math
  - Skill in interpreting only
    - Just enough knowledge in both areas

English

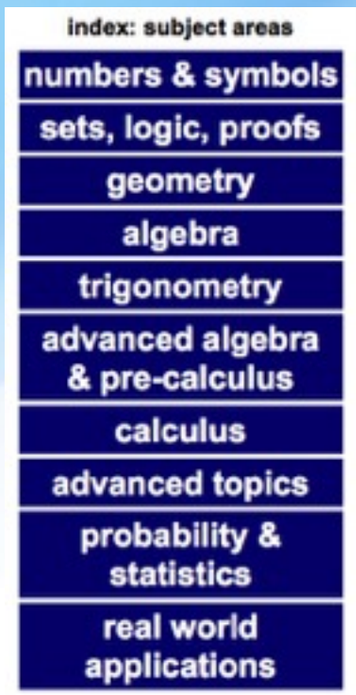
MATHEMATICAL KNOWLEDGE REQUIREMENTS

http://www.mathwords.com/



- At least an ability entry level College Mathematics
- Mathematical Logic
- Greater mathematic ability ≠ Greater ability to interpret
- Ability to understand & pronounce math language

English

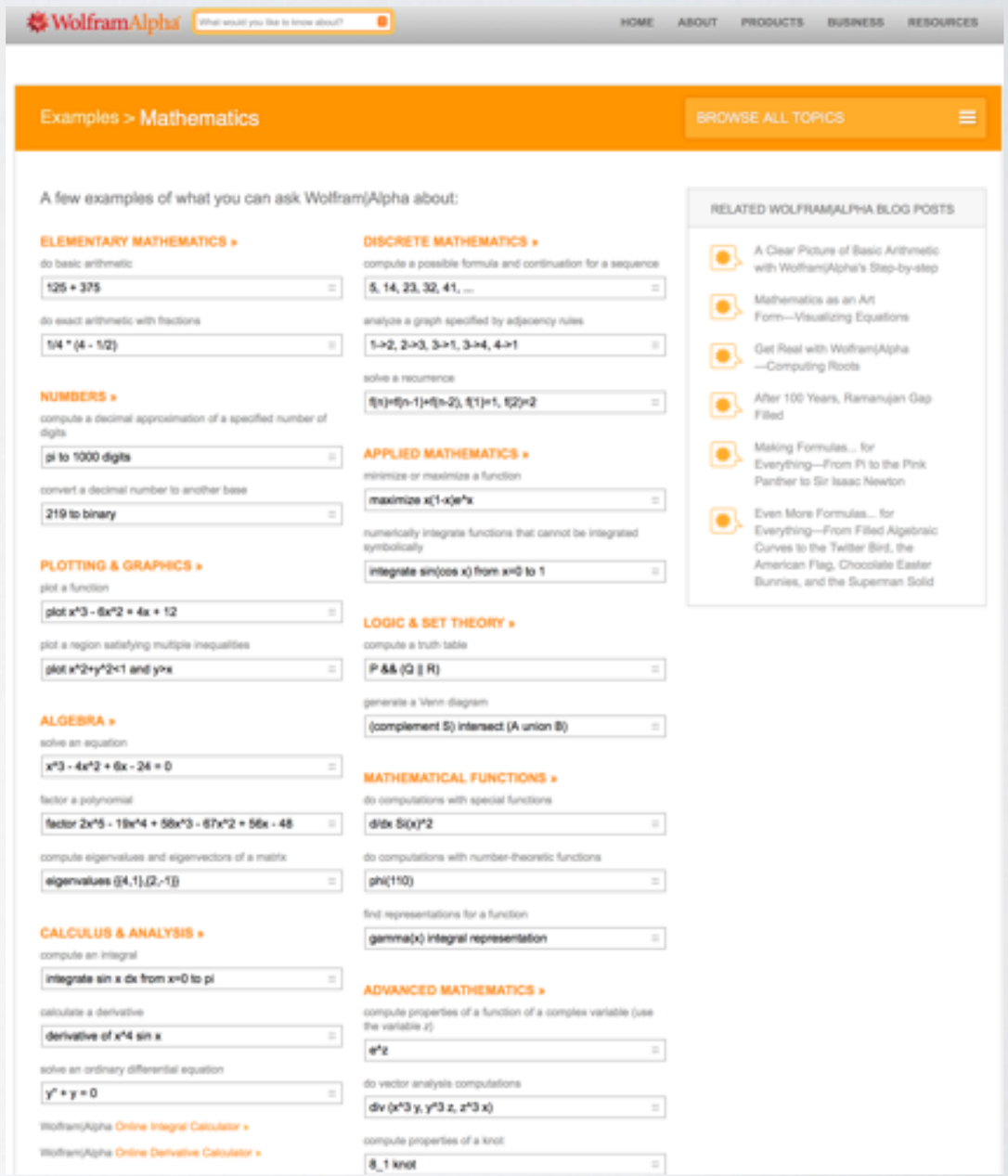


TO UNDERSTAND THE MATH

- https://www.wolframalpha.com/examples/Math.html

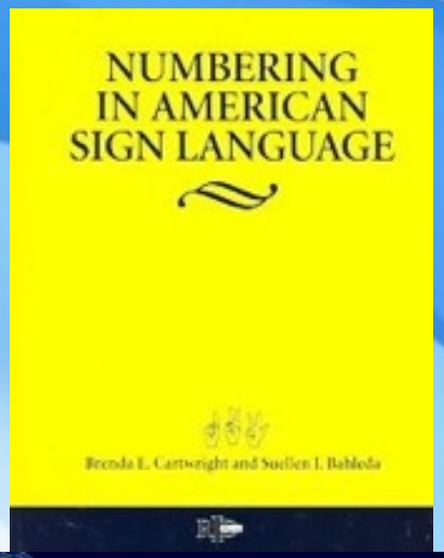
- WolframAlpha apps for iPhone / iPad / Android / Kindle fire / Windows Phone / Windows Tablet

- Course Assistant Apps

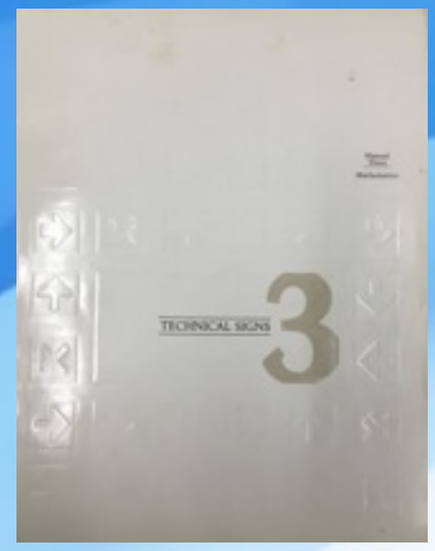


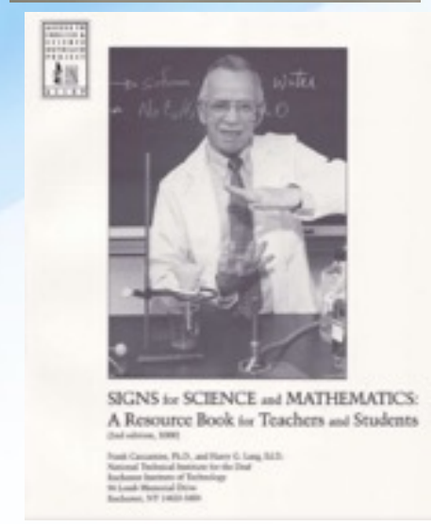
English

ASL KNOWLEDGE REQUIREMENTS



- ASL Number Linguistics
- Math Signs (books / online)





http://www.tsdvideo.org/

https://www.youtube.com/watch?v=SbqhiijIztc

- https://www.shodor.org/deafstemterms/
  etc…

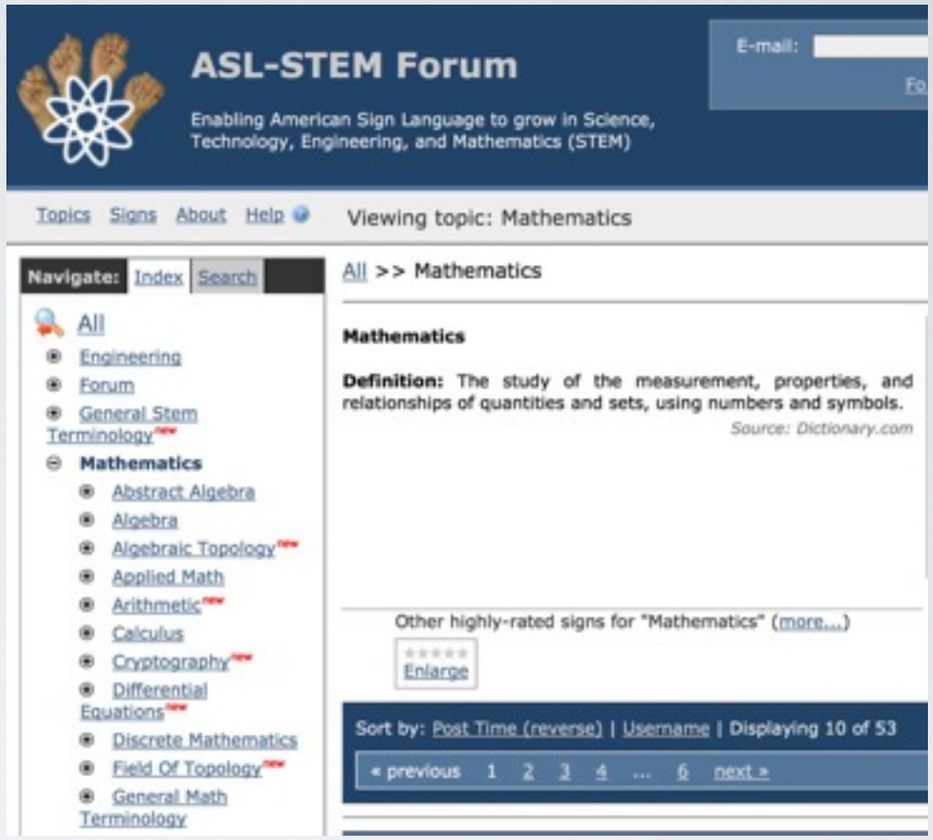
- High vs Low Context

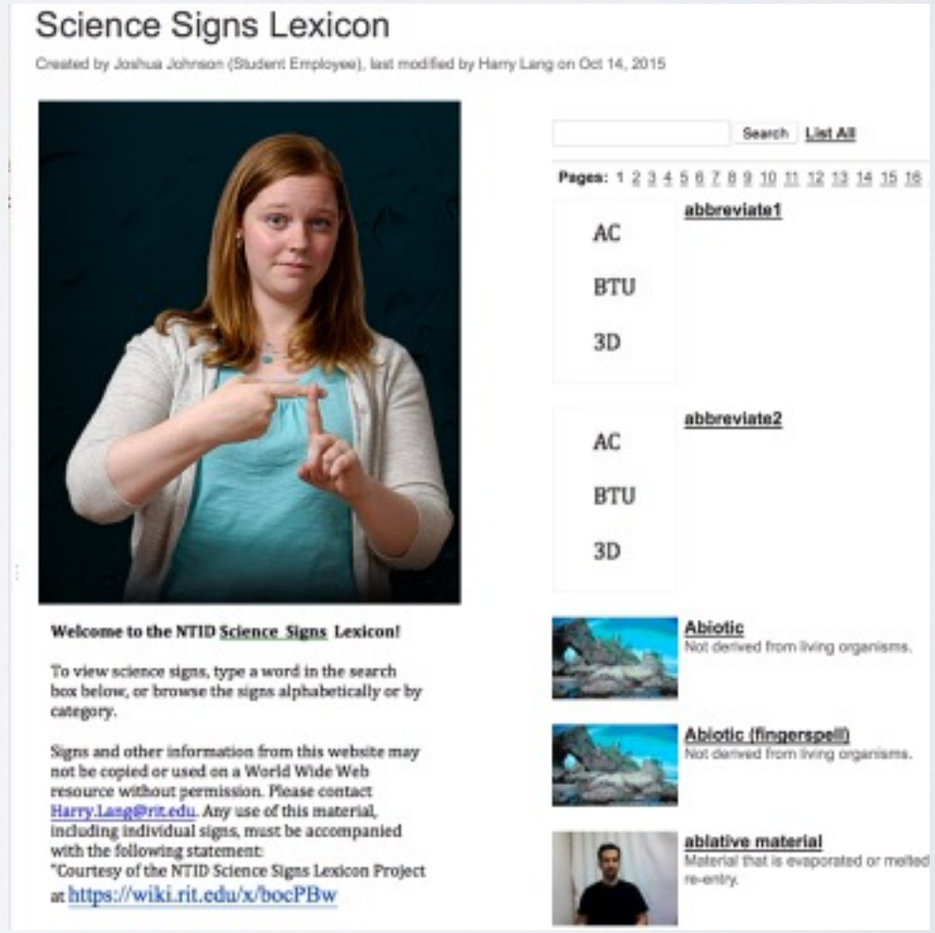
ASL

COLLEGIATE LEVEL ASL

https://aslstem.cs.washington.edu/topics/view/10

https://wiki.rit.edu/display/sciencelexicon/Science+Signs+Lexicon





ASL

LINGUISTIC KNOWLEDGE & SKILLS

- Dimensionality of Hand Shapes
- Space use as applied to Mathematics
  - Midline / Signers Perspective / Board perspective / Use of board
- ASL signs derived from;
  - concept
  - symbol
- graphical representation

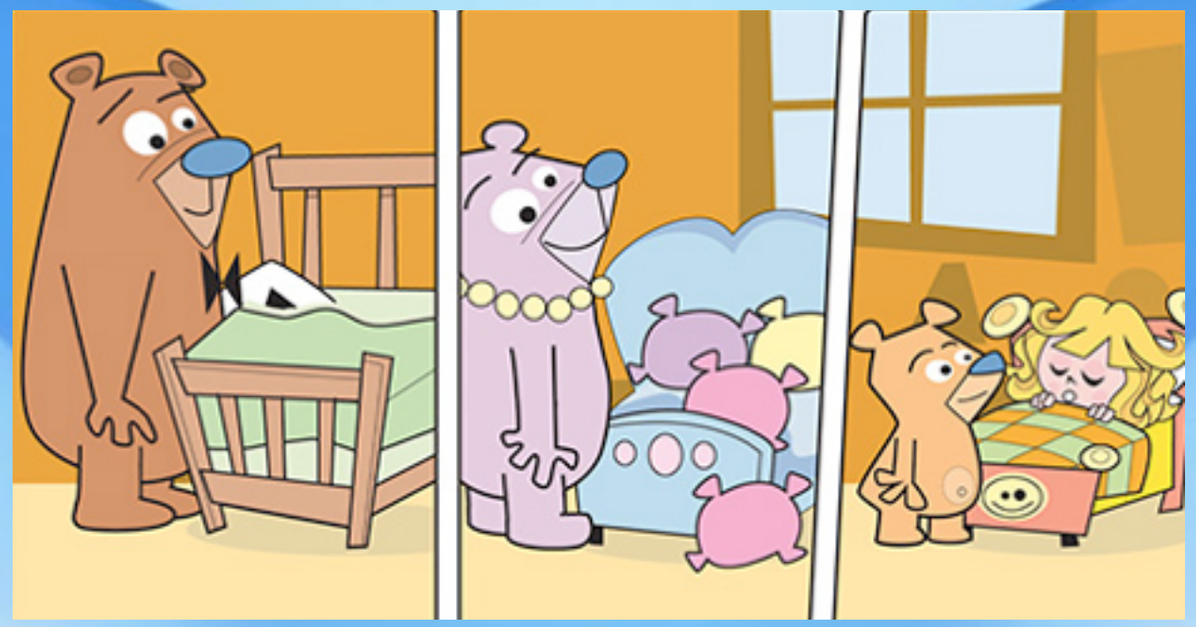
ASL

LINGUISTIC DEARTH CONUNDRUM

- Standardization
- Deaf education
- Pre-invented / Habits
- Immediate vs wholistic

ASL

SIGN CREATION



- ONLY DEAF CAN!!!
  - Terps can but only for somethings
    - Respect vs Expertise

Deaf Mathematician Consultant or
Hearing Mathematician Consultant &
Deaf ASL Linguistic Consultant
Create Signs from Meaning, Symbol, Graphical
representation using CL / DN / DV

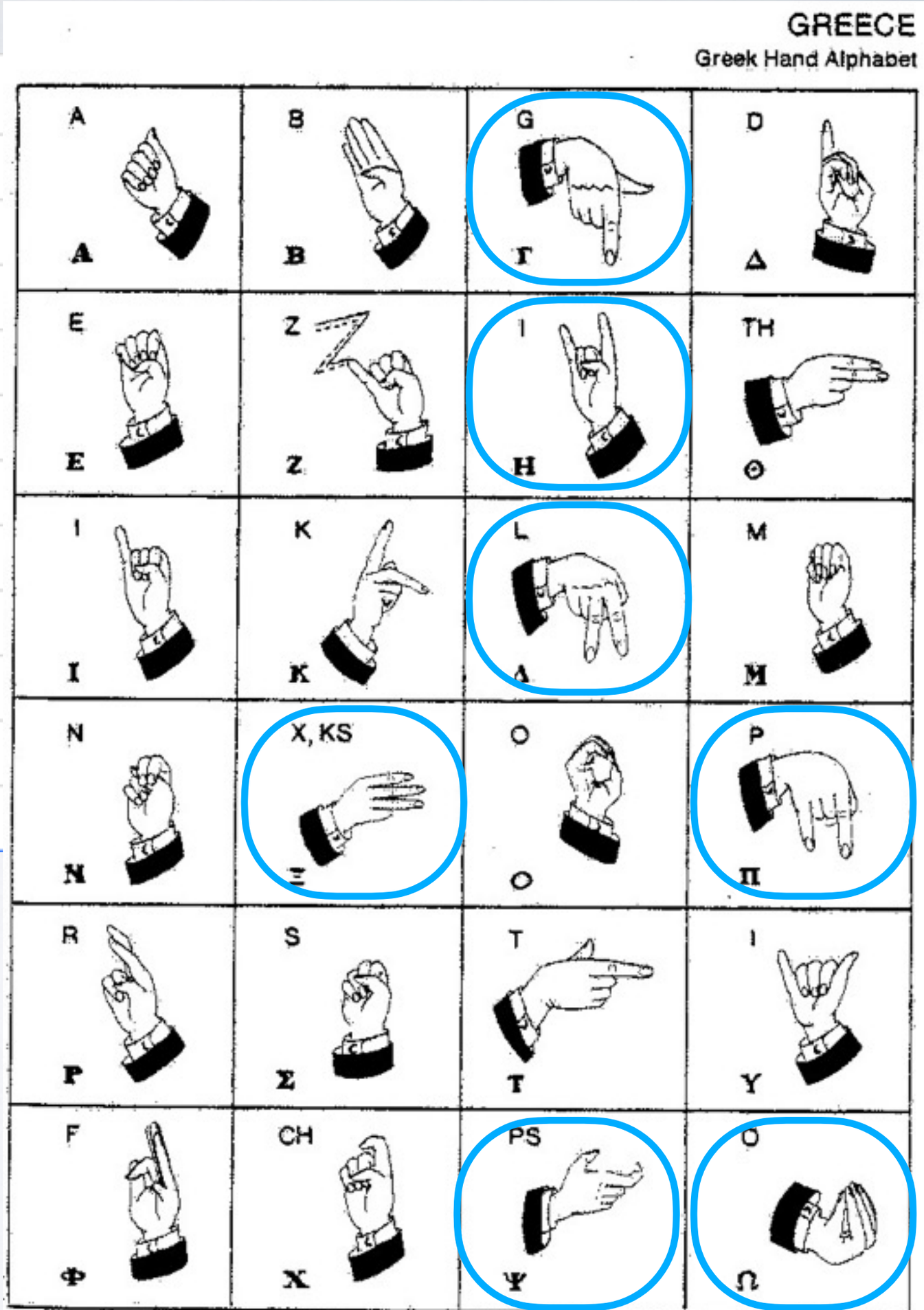
ASL

A α	alpha	Ξ ξ	xi
B β	beta	O o	omicron
Γ γ	gamma	π	pi
Δ δ	delta	P ρ	rho
E ε	epsilon	Σ σ	sigma
Z ζ	zeta	T τ	tau
H η	eta	Y ν	upsilon
Θ θ	theta	Φ φ	phi
K κ	kappa	X x	chi
Λ λ	lambda	Ψ ψ	psi
M μ	mu	Ω ω	omega
N ν	nu		

GREEK ALPHABET

Established Signs
ASL Linguistics applied
GSL / Draw / 2 Handed / Spell /
Capitalization

ASL



MATHEMATIC SYMBOLS

ASL Linguistics applied
Signs / Draw / 2 Handed
ASL Nouns vs ASL Verbs
(in ASL)
How they are said
(in English)
plus minus

http://www.rapidtables.com/math/symbols/Basic_Math_Symbols.htm

Basic math symbols

Symbol	Symbol Name	Meaning / definition
=	equals sign	equality
≠	not equal sign	inequality
>	strict inequality	greater than
<	strict inequality	less than
≥	inequality	greater than or equal to
≤	inequality	less than or equal to
( )	parentheses	calculate expression inside first
[ ]	brackets	calculate expression inside first
+	plus sign	addition
−	minus sign	subtraction
±	plus - minus	both plus and minus operations
∓	minus - plus	both minus and plus operations

$\sqrt[3]{a}$	cube root	$\sqrt[3]{a} \cdot \sqrt[3]{a} \cdot \sqrt[3]{a} = a$
$\sqrt[4]{a}$	fourth root	$\sqrt[4]{a} \cdot \sqrt[4]{a} \cdot \sqrt[4]{a} \cdot \sqrt[4]{a} = a$
$\sqrt[n]{a}$	n-th root (radical)	
%	percent	1% = 1/100

ASL

MATH SYMBOLS CONT.

Algebra symbols

Symbol	Symbol Name	Meaning / definition
x	x variable	unknown value to find
$\equiv$	equivalence	identical to
$\triangleq$	equal by definition	equal by definition
$:=$	equal by definition	equal by definition
$\sim$	approximately equal	weak approximation
$\approx$	approximately equal	approximation
$\propto$	proportional to	proportional to
∞	lemniscate	infinity symbol
$\ll$	much less than	much less than
$\gg$	much greater than	much greater than
$( )$	parentheses	calculate expression inside first
$[ ]$	brackets	calculate expression inside first
$\{ \}$	braces	set
$\lfloor x \rfloor$	floor brackets	rounds number to lower integer
$\lceil x \rceil$	ceiling brackets	rounds number to upper integer
$x!$	exclamation mark	factorial
$\lvert x \rvert$	single vertical bar	absolute value
$f(x)$	function of x	maps values of x to f(x)
$(f \circ g)$	function composition	$(f \circ g)(x) = f(g(x))$
(a,b)	open interval	$(a,b) = \{x \mid a < x < b\}$
$[a,b]$	closed interval	$[a,b] = \{x \mid a \le x \le b\}$
Δ	delta	change / difference
Δ	discriminant	$\Delta = b^2 - 4ac$
$\sum$	sigma	summation - sum of all values in range of series

Calculus & analysis symbols

Symbol	Symbol Name	Meaning / definition
$\lim_{x \to x0} f(x)$	limit	limit value of a function
ε	epsilon	represents a very small number, near zero
e	e constant / Euler's number	$e = 2.718281828...$
y'	derivative	derivative - Lagrange's notation
y''	second derivative	derivative of derivative
$y^{(n)}$	nth derivative	n times derivation
$\frac{dy}{dx}$	derivative	derivative - Leibniz's notation
$\frac{d^2y}{dx^2}$	second derivative	derivative of derivative
$\frac{d^ny}{dx^n}$	nth derivative	n times derivation
$\dot{y}$	time derivative	derivative by time - Newton's notation
$\ddot{y}$	time second derivative	derivative of derivative
$D_x y$	derivative	derivative - Euler's notation
$D_x^2 y$	second derivative	derivative of derivative
$\frac{\partial f(x,y)}{\partial x}$	partial derivative	

$\int$	integral	opposite to derivati
$\iint$	double integral	integration of funct of 2 variables
$\iiint$	triple integral	integration of funct of 3 variables
$\oint$	closed contour / line integral	
$\oiint$	closed surface	

Combinatorics Symbols

Symbol	Symbol Name	Meaning / definition
$n!$	factorial	$n! = 1 \cdot 2 \cdot 3 \cdot ... \cdot n$

∇	gradient	
	del; nabla; gradient of	$\nabla f(x_1, ..., x_n)$ is the vector of partial derivatives $\partial / \partial x_n$.
	vector calculus	
	divergence	
∇	del dot; divergence of	$\nabla \cdot \vec{v} = \frac{\partial v_x}{\partial x} + \frac{\partial v_y}{\partial y} + \frac{\partial v_z}{\partial z}$
	vector calculus	
	curl	
	curl of	$\nabla \times \vec{v} = \left(\frac{\partial v_z}{\partial y} - \frac{\partial v_y}{\partial z}\right)\mathbf{i} + \left(\frac{\partial v_x}{\partial z} - \frac{\partial v_z}{\partial x}\right)\mathbf{j} + \left(\frac{\partial v_y}{\partial x} - \frac{\partial v_x}{\partial y}\right)\mathbf{k}$
	vector calculus	

ASL then English

$\mathcal{L}$	Laplace transform	$F(s) = \mathcal{L}\{f(t)\}$
$\mathcal{F}$	Fourier transform	$X(\omega) = \mathcal{F}\{f(t)\}$
δ	delta function	

Complex Numbers

$\pi + 3i$

Algebraic Numbers

$9 + 5 \cdot i$

Real Numbers

$e - \pi i$

$1 + i$

Irrational Numbers

Rational Numbers

$\frac{2}{3}$

$\sqrt{2}$

Integers

$\frac{97}{32}$

-5

Whole Numbers

Transcendental Numbers

$-\sqrt{5}$

Counting

Natural

0

π

1

99

e

2

$\sqrt[3]{26}$

-99

Pure Imaginary Numbers

i

$5 \cdot i$

ei

πi

ASL then English

CHALLENGES ENGLISH

- Classroom Logistics
- Accents
- Vocabulary
  - small words / maximum importance
    - "oh", little oh, a zero vs is zero, nought
    - of () is = over / e to the k 0
    - Z bar
    - Log / log / ln
    - Prime / exponent I
    - Argument, term
    - SINH ~ SINCH COSH ~ hyperbolic cosine (+- sign vs SIN)
    - Blow up

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

$$\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$$

$$\pi\,(R\sin(\theta))^2$$

$$\pi\cos\left(R^2\right)$$

$$a^b$$

English

SELECT VOCABULARY

- Matrix
- Ansatz
- Transform /ation
- Basis
- Coefficient
- Constant
- Variable
- Conjugate
- Diagonalize
- Cross / Dot Product
- Exponential
- Orthogonal
- Vector

Linear Algebra Glossary http://web.mit.edu/18.06/www/Essays/glossary.pdf

NAMES

- Bernoulli
- Cartesian
- Cauchy
- Goursat
- Dirichlet
- Fermat
- Fibonacci
- Fourier
- Eigen
- Euler
- Galois
- Gaussian
- Hamiltonian
- Hilbert
- Lagrangian
- Laplace
- L'hopital
- Newton
- Pascal
- Poynting (vector)
- Riemann
- Taylor
- Turing

English

INTERPRETING EXERCISE

$$\int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}$$

$$f(x) = a_0 + \sum_{n=1}^{\infty} \left(a_n \cos\frac{n\pi x}{L} + b_n \sin\frac{n\pi x}{L} \right)$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

INTERPRETING EXERCISE

$$\frac{\partial^2}{\partial x^2}\left(h(x)\,\varphi(y)\right)+\frac{\partial^2}{\partial y^2}\left(h(x)\varphi(y)\right)=0$$

$$\varphi(y)\frac{d^2h}{dx^2}+h(x)\frac{d^2\varphi}{dy^2}=0$$

$$\frac{1}{h}\frac{d^2h}{dx^2}=-\frac{1}{\varphi}\frac{d^2\varphi}{dy^2}$$