Do We Have a Resource for You! Learning and Teaching the Nemeth Code within UEB Contexts: A Step-by-Step Guide

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Quick Announcements

- Seeking individuals working with braille readers using Chromebooks and Android apps. We want to learn about your experiences and the apps and tools used by your students for math learning. If you have time to share, email Tina Herzberg at herzberg@uscupstate.edu.
- We just opened up our Project INSPIRE Mathlete Competition for braille readers in grades 6-12. Learn about the competition by visiting https://www.pathstoliteracy.org/resource/mathlete-competition/.

Objectives

Participants will be able to:

- Identify which components they find most useful within the chapters of *Learning and Teaching the Nemeth Code within UEB Contexts: A Step-by-Step Guide*.
- Explain how to use the practice activities to sharpen their Nemeth Code skills.
- List five instructional ideas presented in the book.

Rationale for the Development of the Book

- Proficiency in the Nemeth Braille Code is essential for accessing grade-level mathematics and science materials for Pre-Kindergarten-12th grade students who read braille.
- Confidence of TSVIs in Nemeth Code and in math skills varies.
- Some TSVIs are unsure of when and how to introduce students to the Nemeth Code.

Available on the Paths to Literacy Website

(in print and braille at no cost)

Learning and Teaching the Nemeth Code within UEB Contexts: A Step-by-Step Guide

Layout of Each Chapter

- Introduction to new Nemeth symbols
- Practice activities
- Teaching tips
- References for where to find additional information about the Nemeth symbols
- Chapter summary

When Should Math Braille Instruction Begin?

- Never too young!!
- Begin in preschool
- Braille Math Blocks (in Nemeth Code) from Uncle Goose

Chapter 1: Nemeth Code Symbols Used in Grades PK-1

New Symbols Introduced

 [dots 3-4-5-6] Numeric indicator (no print equivalent)

 [dot 6] Mathematical comma (,)

 [dots 4-5-6] Punctuation indicator (no print equivalent)

 [dots 4-5-6] Tally mark or hash mark (|)

 [dots 1-2-3-4-5-6] General omission symbol (represents a question mark or blank space standing for a missing symbol)

 [dots 3-4-6] Plus sign (+)

 [dots 3-6] Minus sign (−)

 [dots 4-6, dots 1-3] Equals sign (=)

 [dot 5, dots 1-3] Less than sign (<)

 [dots 4-6, dot 2] Greater than sign (>)

New BANA Terms

Centered heading: Term used for titles.

Key Points

- A **numeric indicator** is used to alert the braille reader to a number written in Nemeth Code.
- In Nemeth Code numbers are written in the lower part of the cell.
- The **mathematical comma** is used to separate numbers.

Sample Content in Chapter 1

Mathematical Comma

Students learn to read and write the **mathematical comma** (Rule II, §8b) in a series of numbers in the early grades (Maryland Department of Education, 2015). The dot 6 represents the mathematical comma.

In Example 1.3, there is a mathematical comma after the numbers 28 and 29. Just like in print, there is not a space between the number and the mathematical comma. In contrast, there is a space between the comma and the following number.

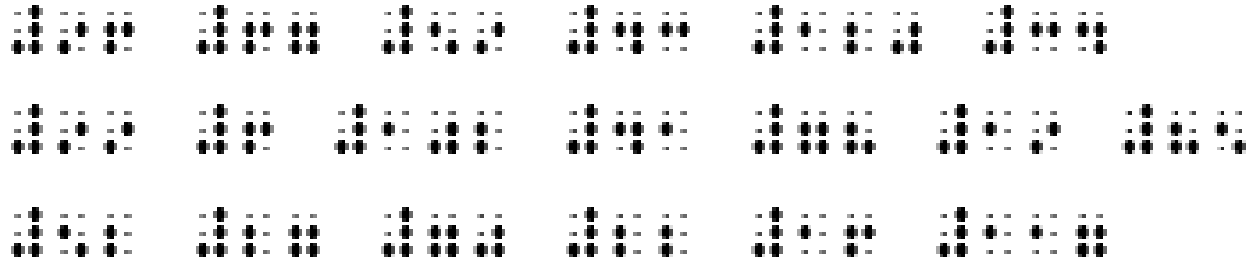
Example 1.3

28, 29, 30

Practice 1.2

Practice 1.2

Interline the numbers.



Write the following numbers in braille.

74 81 113 9 26 57

63 48 21 73 45 108

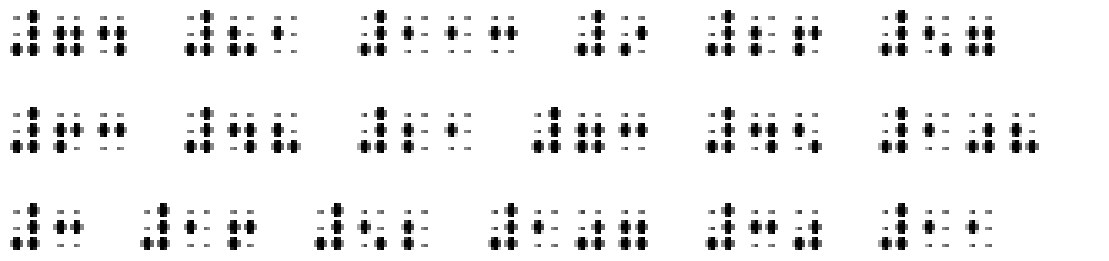
3 16 52 107 30 11

Answer 1.2

96 67 59 43 120 34

99 6 102 41 78 19 85

52 27 70 22 16 117



Teaching Tip in Chapter 1

Brailling the Equals Sign (=) ⠶

- Begin brailling using two fingers of the right hand.
- Then follow with two fingers of the left hand.
- Memory cues:
  - Two fingers are “equal to” two fingers.
  - Two dots are “equal to” two dots.

Chapter 2: Additional Nemeth Code Symbols and Formats Used in Grades PK-1

New Symbols Introduced

 [dots 4-5-6, dots 1-4-6] Opening Nemeth Code indicator (no print equivalent)

 [dots 4-5-6, dots 1-5-6] Nemeth Code terminator (no print equivalent)

 [dot 6, dot 3] Single-word switch indicator (no print equivalent)

 [dots 5-6] English letter indicator (no print equivalent)

 [dot 3, dot 3, dot 3] Ellipsis (…)

 [dots 3-6, dots 3-6, dots 3-6, dots 3-6] Long dash (_____)

 [dot 4, dots 4-6, dots 1-2-6] Opening transcriber's note indicator (no print equivalent)

 [dot 4, dots 4-6, dots 3-4-5] Closing transcriber's note indicator (no print equivalent)

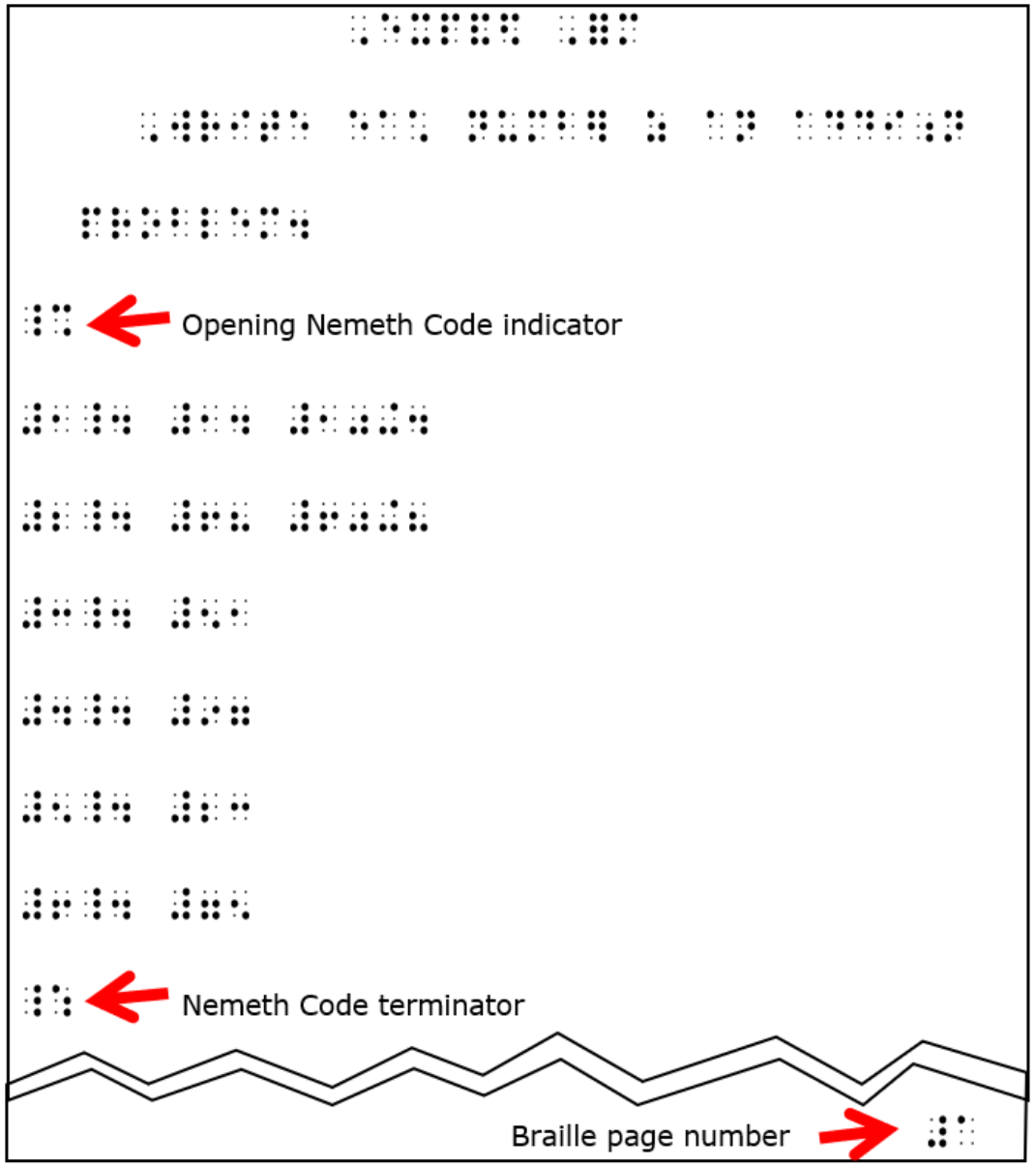
Example in Chapter 2

Example 2.1

Expanded Form

Write each number as an addition problem.

1. 14	10 + 4
2. 68	60 + 8
3. 51	
4. 97	
5. 23	
6. 75	



Chapter 2 Summary

Chapter Summary

Tips for Using Nemeth Code Switch Indicators

- Use Nemeth Code when transcribing all math and science notation (BANA Guidance, 2018, p. 1-2), including:
  - Parts of formulas
  - Expressions, equations, and/or inequalities
  - Signs of operation
  - Signs of comparison
- The opening Nemeth Code indicator is (*UEB Rulebook*, 14.6.2 and 14.6.3)
  - placed before the math material
  - followed by a space
  - placed before the sequence to which it applies, on a separate line, or at the end of the previous line of UEB text
- The Nemeth Code terminator is (*UEB Rulebook*, 14.6.2 and 14.6.3)
  - placed after the math material
  - preceded by a space
  - placed after the sequence to which it applies, on a separate line, or at the end of the previous line of math material

Chapter 3: An Introduction to Nemeth Code Symbols Used in Grades 2-6

Symbols for Dollars and Cents

Students are introduced to the monetary signs for dollars and cents in second grade (Common Core State Standards Initiative, 2010; Maryland State Department of Education, 2015).

It takes two cells to write the **dollar sign** in Nemeth Code. It is written with dot 4 in the first cell, followed by dots 2-3-4 in the second cell.

$

> **Teaching Tip:** Point out that many of the print symbols (such as dollar, cent, and percent signs) begin with the dot 4 in Nemeth Code.
>
> **Teaching Tip:** It may be easier for students to learn the symbol for the dollar sign as dot 4, followed by the letter s. Students may also be interested to know that the letter s is used because the print symbol for the dollar includes an "s" with a line drawn through it.

When a dollar sign is used in Nemeth Code, do not include a numeric indicator (Rule XXII, §162). In addition, there is no space between the dollar sign and the first number.

Practice 3.4

Practice 3.4

Interline the numbers with an underlined digit.

Now write the following numbers with an underlined digit in braille. Don't forget to number your problems.

1. 6̲55,875
2. 12̲7.93
3. 456,451,814̲,221
4. 793̲.784
5. 8.929̲

Answer 3.4

.003̲

55.1̲9

1,3̲29.4

40,0̲00,000

38.7̲

90,025.61̲3

Chapter 4: Spatial Arrangements and Number Lines Used in Grades K-6

New Symbols Introduced

⠿⠿⠿⠿ [dots 2-3-5-6, dots 2-3-5-6, dots 2-3-5-6, dots 2-3-5-6] Carried number indicator (length varies; no print equivalent)

⠒⠒⠒⠒ [dots 2-5, dots 2-5, dots 2-5, dots 2-5] Separation line used in spatially aligned addition, subtraction, and multiplication, and division problems as well as in conjunction with the divided into sign (_____)

⠌ [dots 1-3-5] Division sign or divided into (⟌)

Number line symbols

⠣ [dots 2-4-6] Left-pointing arrowhead

⠒ [dots 2-5] Line (axis line)

⠳ [dots 1-2-3-5] Coordinate scale mark (tick mark)

⠜ [dots 1-3-5] Right-pointing arrowhead

⠿ [dots 1-2-3-4-5-6] Solid or filled-in circle above the number line (point)

New BANA Terms

- **Spatial arrangement:** A math problem that is written vertically (one number over the other) is called a spatial arrangement.

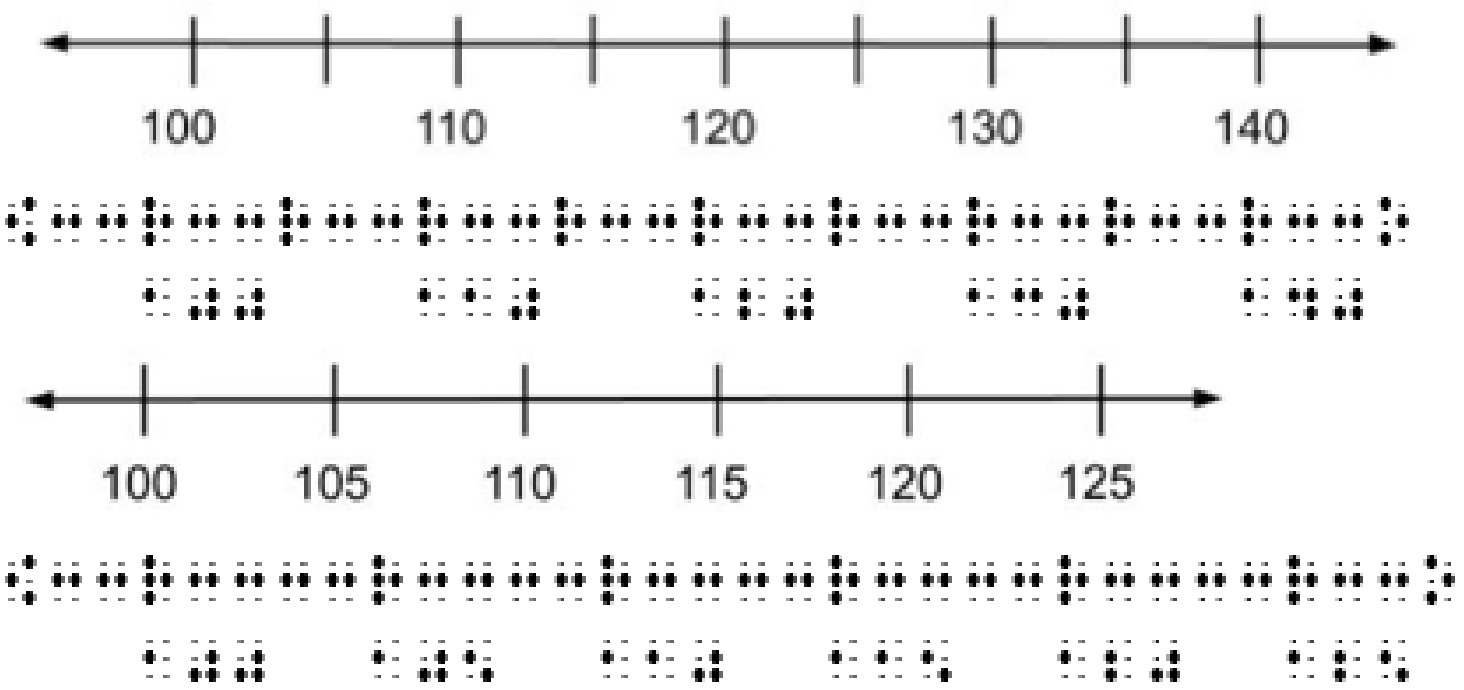
Key Points

- In a vertically aligned problem (spatial arrangement), the **addition** or **subtraction sign** goes one cell to the left of the widest number in the problem.

Example 4.18

Example 4.18 includes two number lines with labeled scale marks. The first number line includes alternate labels from 100 to 140, and the second number line from 100 to 125 includes an increased length of space between the units. Both versions are correct.

Example 4.18



Sample Chapter 4 Teaching Tips

- Spatially aligned problems have a “window” around them. This means there is a blank line above and below the problem. If more than one spatially aligned problem is on the same line, there must be at least one blank cell between the problems.
- Although it is time consuming, it is important that students can perform long division on a braillewriter. This will be revisited in high school when they complete long division problems with polynomials.
- Once students have demonstrated that they can perform long division on a braillewriter, they may use an abacus for division problems and then write out the final answer for the math teacher. This will be much quicker for the student.

Chapter 4 Summary

Chapter Summary

Spatial Arrangements

- When problems are written vertically in print, they are written vertically in Nemeth Code.
- There should always be a blank line above and below spatially aligned problems (Rule XXV, §185).
- Numeric indicators are not used in spatial arrangements, and single line spacing is used throughout the problem, even for young students (Rule II, §11b).
- The separation line extends one cell to the left and one cell to the right of the widest arrangement in the problem (Rule XXIV, §178c).
- When transcribing vertically aligned numbered problems, leave a blank cell between the problem number and the beginning of the separation line (Rule XXV, §185b).
- When vertically aligned problems are placed side-by-side in print, there must be at least one blank cell between the separation lines in braille (Rule XXV, §185c).
- Leave two blank cells between the end of a separation line and the following problem number (Rule XXV, §185c).
- The plus or minus sign is placed one cell to the left of the widest number above the separation line in the arrangement (Rule XXIV, §178c).

Chapter 5: Fractions and Mixed Numbers

Chapter 5: Fractions and Mixed Numbers

New Symbols Introduced

⠻ [dots 1-4-5-6] Opening simple fraction indicator (no print equivalent)

⠽ [dots 3-4-5-6] Closing simple fraction indicator (no print equivalent)

⠉ [dots 3-4] Horizontal fraction line (–)

⠻⠉ [dots 4-5-6, dots 3-4] Diagonal fraction line (/)

⠻⠿ [dots 4-5-6, dots 1-4-5-6] Opening mixed number fraction indicator (no print equivalent)

⠻⠽ [dots 4-5-6, dots 3-4-5-6] Closing mixed number fraction indicator (no print equivalent)

Key Points

- **Simple fractions** begin with the opening simple fraction indicator. The closing simple fraction indicator ends a fraction. There are no print equivalents for these symbols.
- In a simple fraction, follow the print and use either the **horizontal** or **diagonal fraction line** to separate the numerator and denominator. The diagonal fraction line is sometimes called a slash.
- When a simple fraction includes a **diagonal fraction line**, pay attention to position of the numerator and denominator to know how to braille the simple fraction.

Sample Chapter 5 Content

Fractions with a horizontal fraction line are enclosed by opening and closing simple fraction indicators (Rule XII, §62a). There are no print equivalents for these indicators. An **opening simple fraction indicator** is written with dots 1-4-5-6 in Nemeth Code.

Teaching Tip: It may be helpful to point out that the opening simple fraction indicator contains the same dots as the "th" groupsign.

A **closing simple fraction indicator** is written with dots 3-4-5-6 in Nemeth Code.

Teaching Tip: It may be helpful to point out that the closing simple fraction indicator contains the same dots as the numeric indicator.

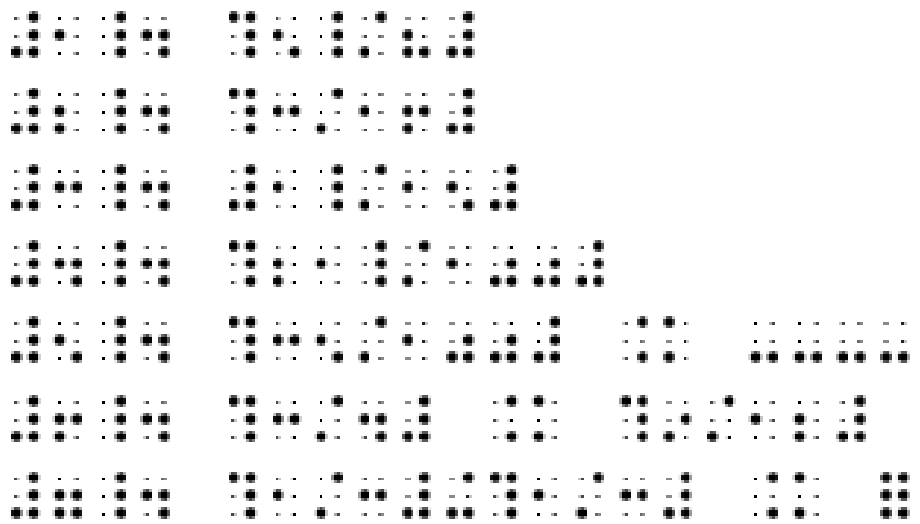
Similar to UEB, the same dot configuration sometimes represents multiple items in the Nemeth Code, depending on the placement and context of the braille dot configuration.

Teaching Tip: Remind students to always "close" what they "open". Thus, if they begin with an opening simple fraction indicator, they will need a closing simple fraction indicator at the end of the fraction.

Practice 5.1

Practice 5.1

Interline the following simple fractions and problems containing simple fractions. Pay special attention to the fraction line to determine if it is a horizontal fraction line or a diagonal fraction line.



Answer 5.1

1. $5/8$
2. $\frac{3}{16}$
3. $1/15$
4. $21/100$
5. $\frac{35}{100} = \_\_\_$
6. $\frac{3}{4} = \frac{9}{12}$
7. $\frac{1}{3} + \frac{1}{3} = ?$

Chapter 6: Symbols Used in the Middle Grades

Key Points

- **Variables** are letters that represent unknown numbers.
- Do not use an English letter indicator with a variable that is in a math expression.
- Do not italicize variables in braille.
- **Parentheses** are **grouping symbols** that usually have a beginning and an ending, often called an opening and a closing parenthesis.
- **Brackets** are also **grouping symbols** that are used as a second level of parentheses.
- **Braces** are also a type of **grouping symbol**. They are used as a third level of parentheses. They are also sometimes called curly brackets.
- **Absolute value** is represented by a vertical bar on each side of a number or expression.
- With a few exceptions such as numbers in matrices and equations in enlarged braces in Algebra, the numeric indicator is not used within grouping symbols.
- Do not use the English letter indicator when a single letter is enclosed in grouping symbols.
- Sometimes a closing parenthesis follows a problem number. When this occurs, the numeric indicator is used.
- **Negative numbers** are numbers that are less than zero. The negative sign is placed before the numeric indicator when writing a negative number.

Example 6.5

Example 6.5

$8 + (-1) = 7$ Eight plus negative one equals seven.

$(-7) + (-4) = -11$ Negative seven plus negative four equals negative eleven.

$-15x + 11 = -4$ Negative fifteen x plus eleven equals negative four.

$-2 < 2$ Negative two is less than two.

Chapter 7: Geometry for All Grade Levels

Chapter 7: Geometry for All Grade Levels

New Symbols Introduced

Shapes

⠸ [dots 1-2-4-6] Shape indicator (no print equivalent)

⠸⠈ [dots 1-2-4-6, dots 1-4] Circle (○)

⠸⠒ [dots 1-2-4-6, dots 2-5-6] Square (□)

⠸⠸ [dots 1-2-4-6, dots 2-5-6] Parallelogram (▱)

⠸⠢ [dots 1-2-4-6, dots 2-3-4-5] Triangle (△)

⠸⠳ [dots 1-2-4-6, dots 1-2-3-5] Rectangle (▭)

⠸⠈ [dots 1-2-4-6, dots 1-4-5] Diamond (◇)

⠸⠢ [dots 1-2-4-6, dots 2-4-6] Angle (∠)

⠸⠳ [dots 1-2-4-6, dots 1-3-5] Right arrow (contracted) (→)

Sample Chapter 7 Content

The lowercase Greek letter **pi**, is written with dots 4-6, followed by the letter "p" which is dots 1-2-3-4. Pi is a popular constant and is the ratio of the circumference of any circle to the diameter of that circle.

π

⠨⠏

Pi is used in geometry formulas such as:

$C = \pi d$

⠉ ⠨⠏ ⠙

$A = \pi r^2$

⠁ ⠨⠏ ⠗⠘⠆

$V = \frac{4}{3}\pi r^3$

⠧ ⠼⠙⠌⠼⠉ ⠨⠏ ⠗⠘⠒

Sample Chapter 7 Teaching Tips

- Comparison signs can be negated by placing dots 3-4 before the symbol in Nemeth Code. Therefore, the is not congruent to symbol and the not equal to symbol both begin with dots 3-4.
- $\angle ABC$ (read as angle ABC) denotes the angle itself, whereas $\mathrm{m}\angle ABC$ (read as the measure of angle ABC) is its measure. Angles can be congruent to each other, and the measures of angles can be equal to each other.
- It is important that students see multiple ways of transcribing the same thing, such as a transformation. Take time to familiarize students with different ways to present the same material so that if they come across different presentations on tests or in textbooks, they are able to read and understand them.

Chapter 8: An Introduction to Nemeth Code Symbols Used in Algebra 1, Algebra 2, and Advanced Mathematics

New Symbols Introduced

[dots 1-2-5-6] Vertical bar used with such that, magnitude, norm, and determinants (|)

[dots 1-2-3-4-5-6] Infinity symbol (∞)

[dots 4-6, dots 1-6] Hollow dot (○)

[dots 4-5, dots 4-5] Superscript with superscript indicator

[dots 5-6] Subscript indicator

[dots 1-2-6] Index-of-radical indicator

Grouping Symbols

[dots 4-6, dots 4-6, dots 1-2-3-5-6] Opening (left) angle bracket (⟨)

[dots 4-6, dots 4-6, dots 2-3-4-5-6] Closing (right) angle bracket (⟩)

Enlarged Grouping Symbols

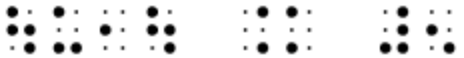
[dot 6, dots 1-2-3-5-6] Enlarged opening (left) parenthesis (( )

[dot 6, dots 2-3-4-5-6] Enlarged closing (right) parenthesis ( ))

Sample Chapter 8 Content

Often a **vector** is represented by a lowercase letter. A vector is an object that has both a magnitude and a direction. Picture a vector as a directed line segment, whose length is the magnitude of the vector and with an arrow on one end indicating the direction. When the name of the vector is placed between two vertical bars, the expression means the **magnitude** of the vector.

$$|u_1| = 5$$



Read: The magnitude of u sub 1 equals 5.

Sometimes the magnitude of a vector is written with two vertical bars before and after, but it still means magnitude whether there is a set of single vertical bars or a set of two vertical bars before and after the name of the vector.

$$\|v\| = \sqrt{x^2 + y^2}$$

Read: The magnitude of v equals the square root of x squared plus y squared end root.

Example 8.8

Example 8.8

$\sqrt[5]{\frac{1}{32}}$

Read: The fifth root of open fraction one over thirty-two close fraction

$\sqrt[4]{y-3}$

Read: The fourth root of y minus three end root

$\sqrt[6]{(x-2)^6}$

Read: The sixth root of open parenthesis x minus two close parenthesis to the sixth power end root

Appendices

- Appendix A: Greek Letters (Complete List) and Greek Alphabet (Examples)
- Appendix B: Biology
- Appendix C: Chemistry
- Appendix D: Periodic Table – This is not the actual periodic table, but it is a list of resources for getting the periodic table instead.
- Appendix E: Physics
- Appendix F: Metric System

Hardy-Weinberg Equations

p (frequency of the dominant allele in a population)
q (frequency of the recessive allele in a population)

$p^2 + 2pq + q^2 = 1$

$p^2 + q = 1$

Project INSPIRE

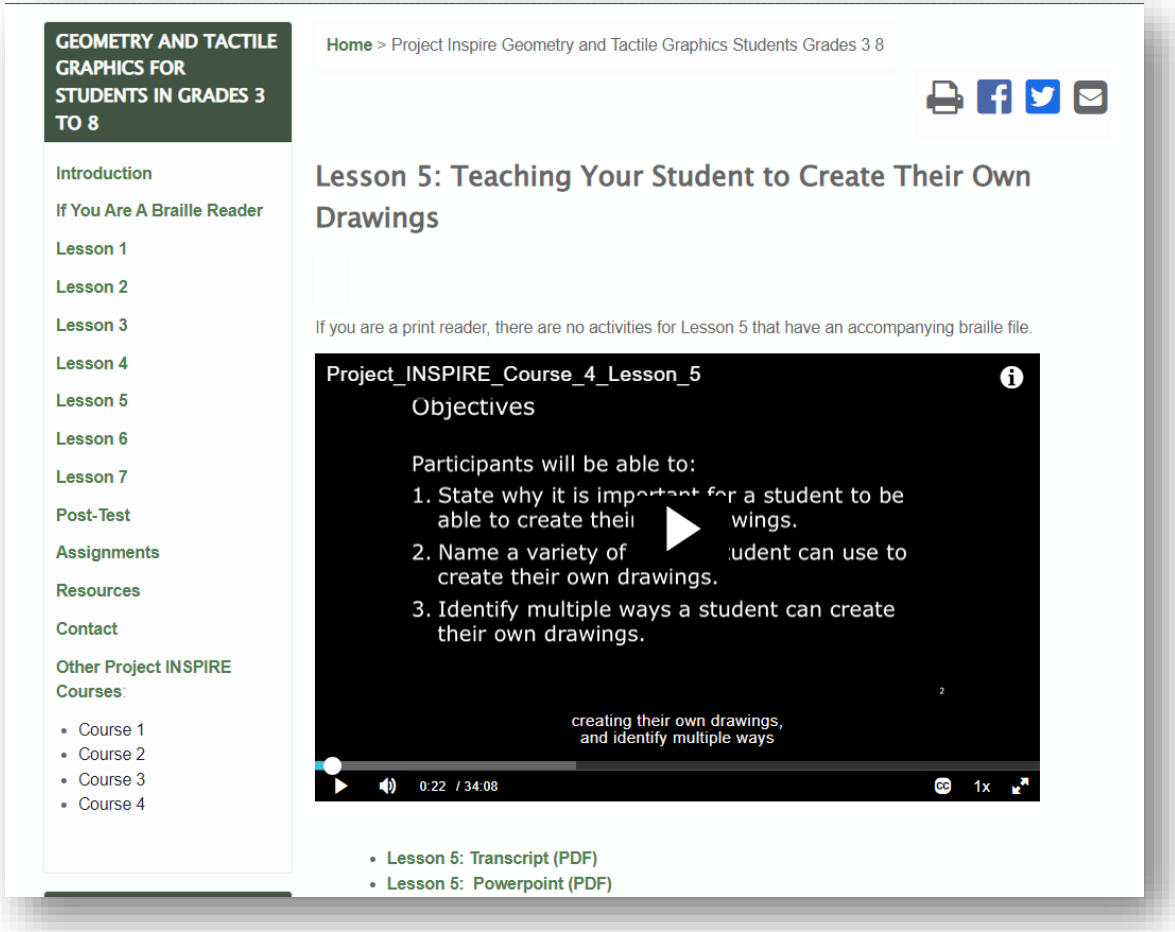
(*Increasing the STEM Potential of Individuals Who Read Braille*)

Our goal is to support professionals, youth in grades 6-12, and young adults in building their skills in the two braille codes used in the United States for STEM classes. To accomplish our goal we are developing and offering:

- Six-week online courses
- STEM Braille Boot Camps
- STEM Braille Bowl Competitions

Seven Professional Development Courses

- Self-paced online, free courses
- Nemeth Code or UEB Math/Science lessons
- Lessons focused on methods and materials used in STEM instruction with braille learners.



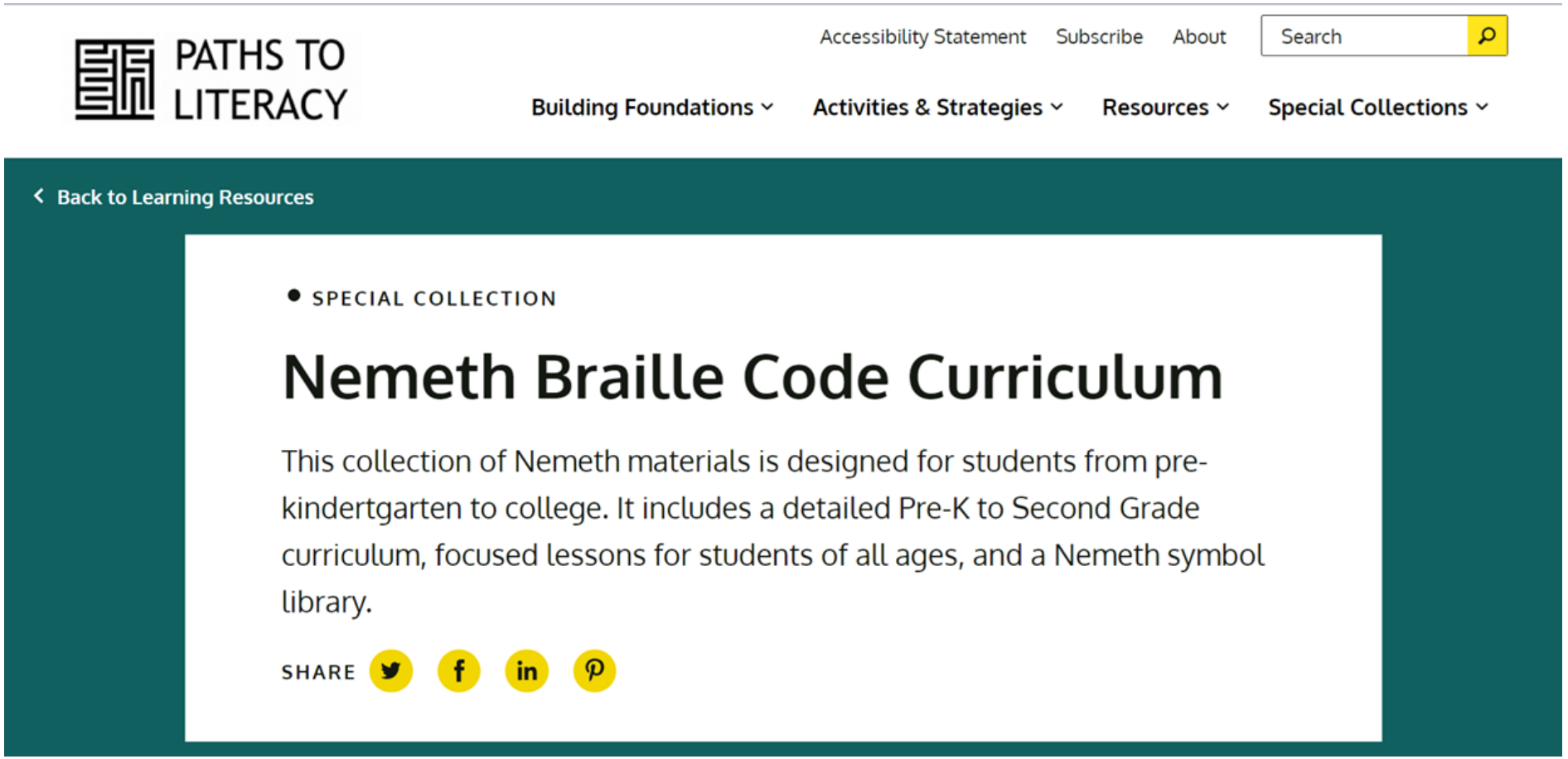
Nemeth in a Box

- Teach Nemeth Code symbols in math context through puzzles and games that challenge students and build their reasoning skills.
- All materials are available in print, SimBraille, and braille.

Mission INSPIRE

- Similar to a science fair.
- Offered in Spring 2022 & Spring 2023
- "Rocket Scientists" ages 11-16:
  - Build a rocket prototype with Mission Control.
  - Build their own rocket and test it.
  - Present their findings to Mission Control staff.

Nemeth Braille Code Curriculum



Nemeth Braille Code Curriculum (Pre-K through 2nd Grade)

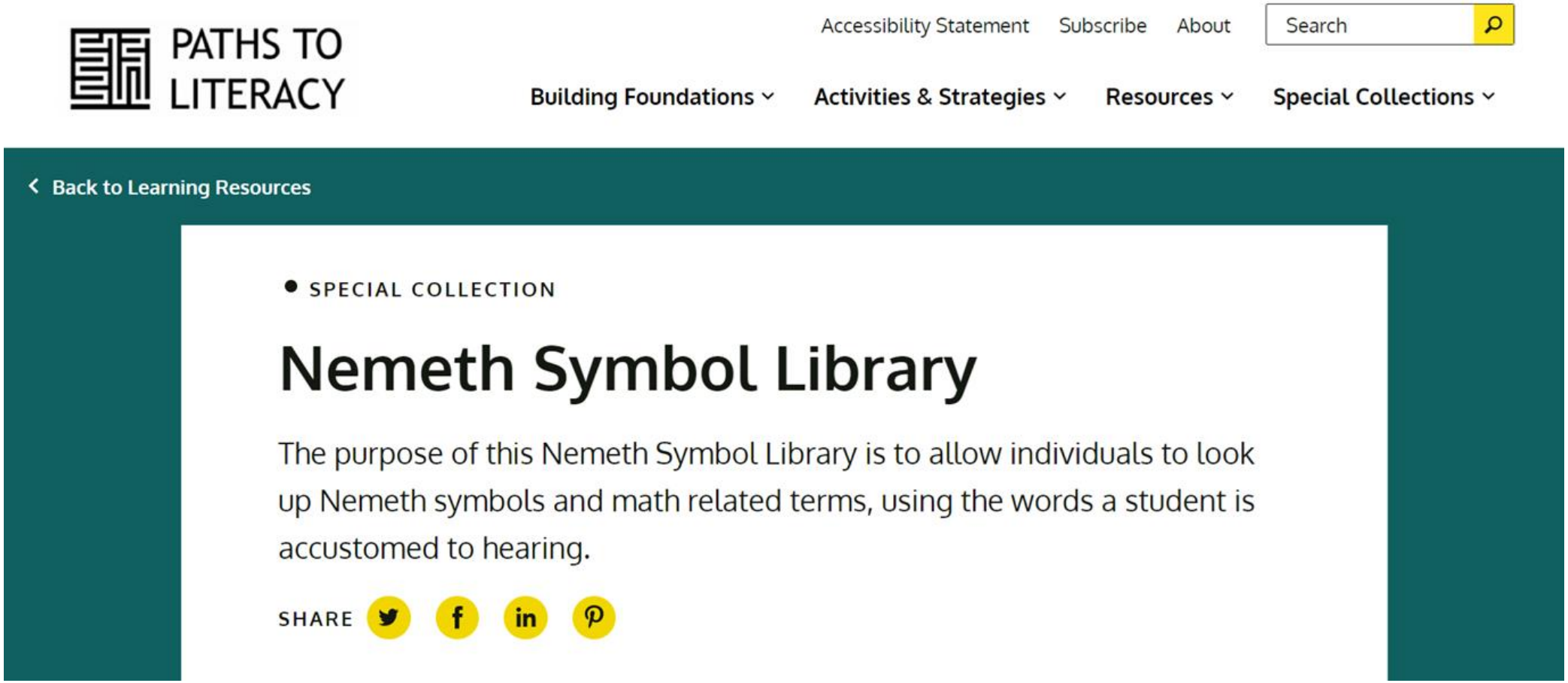
- Teaches students to read and write Nemeth Code within UEB Contexts
- Aligned with the Common Core State Standards (CCSS Initiative, 2010)
- Hands-on games and activities
- Includes teacher scripts, braille ready files for student worksheets, answer keys, data recording sheets, review activities, and assessments

Focused Nemeth Lessons

Students of any age may enjoy and learn from the lessons, especially if they need additional practice.

- Five-Step Rule and Exceptions
- Fractions and Mixed Numbers
- Multiplication and Division
- Number Lines
- Radical Expressions

Nemeth Symbol Library Webpage



Links to All Resources

- Learning and Teaching the Nemeth Code within UEB Contexts: A Step-by-Step Guide https://www.pathstoliteracy.org/resource/learning-and-teaching-the-nemeth-code/
- Uncle Goose https://unclegoose.com/product/braille-math-blocks-2/
- Project INSPIRE https://www.pathstoliteracy.org/project-inspire
- Nemeth in a Box https://www.pathstoliteracy.org/nemeth-box-middle-school-students/
- Mission INSPIRE https://www.pathstoliteracy.org/mission-inspire
- Nemeth Braille Code Curriculum https://www.pathstoliteracy.org/nemeth-curriculum/

NEW Resource

The Nemeth Braille Code for Mathematics and Science Notation 2022

Where to Find Us

- Paths to Literacy https://www.pathstoliteracy.org/project-inspire
- Facebook search for Project INSPIRE
- Sign Up for Mailing list https://bit.ly/3sL8luV
- Our email addresses
  - Tina Herzberg herzberg@uscupstate.edu
  - Susan Osterhaus osterhauss@tsbvi.edu
  - Sara Larkin sara.larkin@iaedb.org
  - L. Penny Rosenblum rosenblu@arizona.edu