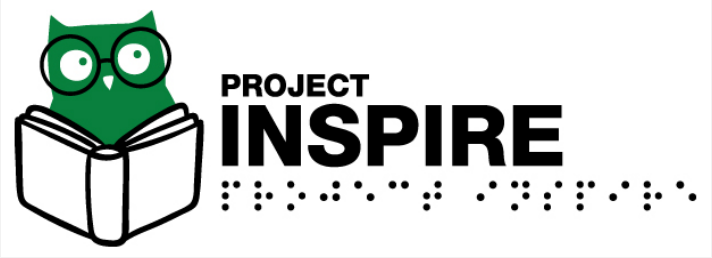
Nemeth Code Symbols Used in the Middle Grades and Strategies for Supporting Math Learning

Lesson 5: Creating Materials for Students to Use in Middle School Math Classes and Preparing Them for High School



University of South Carolina Upstate

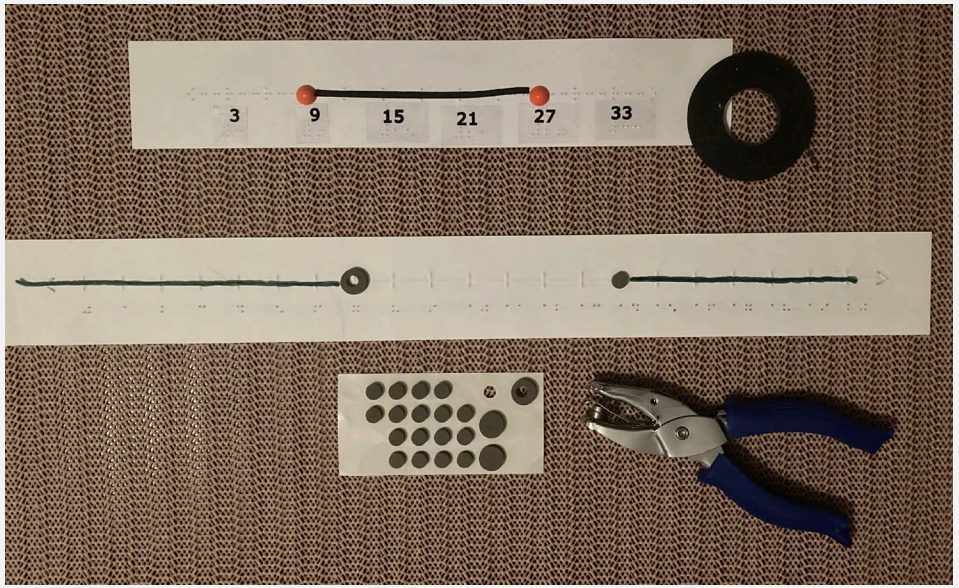
Objectives

Participants will:

- Recognize different types of graphs used at the middle school level and the concepts and terminology students must know.
- Describe the ways in which students can construct different types of graphics used in middle school.
- Explain how a graphing calculator is used by a student.
- Recognize the role of adults and students at the middle school level.
- Describe ways to organize materials and workspaces.

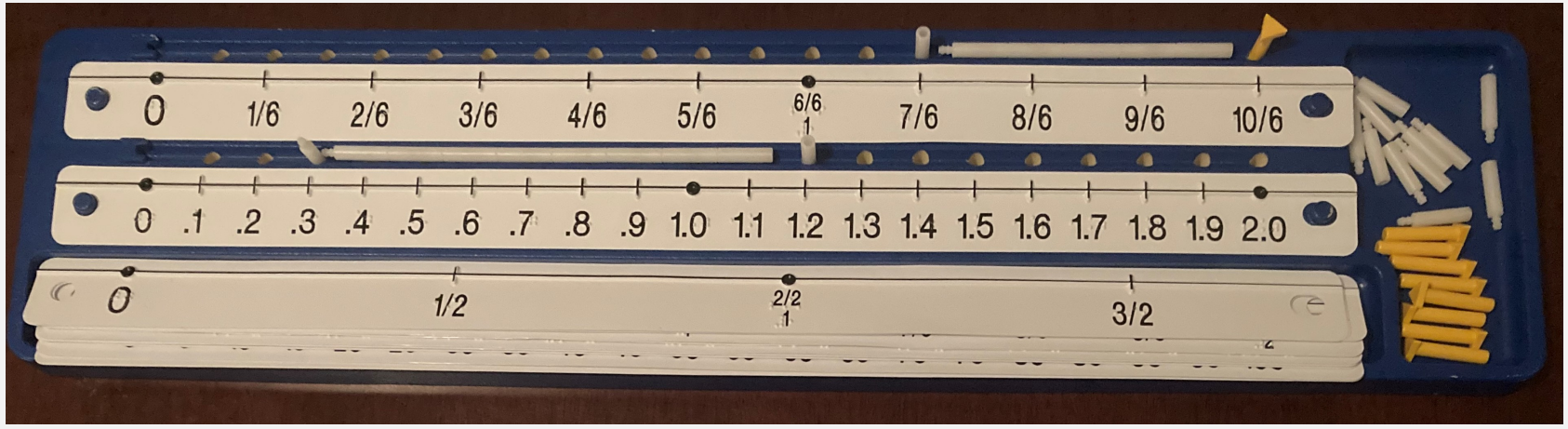
Number Line Graphs

- 6^{th} – 8^{th} grade skill
- Use
  - Braillewriter (best for most students this age)
  - APH Products
    - Number Line Device
    - Consumable number lines
    - Graph paper (single horizontal section)



$9 \leq x \leq 27$

$x < 7 \text{ or } x \geq 14$



$x > \frac{7}{6}$

$0.3 \leq x < 1.2$

Number Line Lessons from Pearson

- 6th – 8th grade skills
- The Pearson number line curriculum includes:
  - Number line no points
  - Number line with points
  - Number line with inequalities
  - Include whole numbers, integers, fractions, decimals, and time

https://accessibility.pearson.com/resources/nemeth-curriculum/grades-three-eight/

Braille number lines can be created with specific Nemeth code number line symbols using a braillewriter. Since number lines take up two lines of braille, a one-line refreshable braille display is not able to display them properly. These tactile number lines are also quite "visual". That is, they look very much like the print versions of number lines. Therefore, it is rather easy for a sighted math teacher to interpret them, once they are given the rules for the various symbols. So, here is what you could teach your math teacher.

The following symbols are used to create number lines:

(dots 2-4-6) left-pointing arrowhead

(dots 2-5) line (axis line)

(dots 1-2-3-5) coordinate scale mark

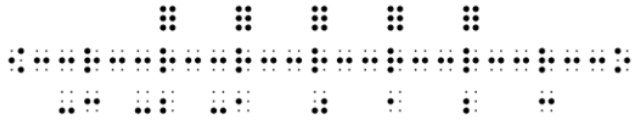
(dots 1-3-5) right-pointing arrowhead

General Instructions

- When graphing points on a number line, first space down two lines.
- Create your number line.
- Place the proper coordinate under each scale mark.
- Above the number line, indicate where you wish to plot points by inserting a closed circle directly above each appropriate coordinate. This could be directly above a scale mark or somewhere in between.

Detailed Examples

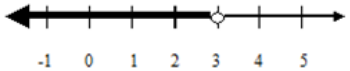
1. Graph the following integers on a number line: -2, -1, 0, 1, 2.



Graphing and Interpreting Inequalities on a Number Line

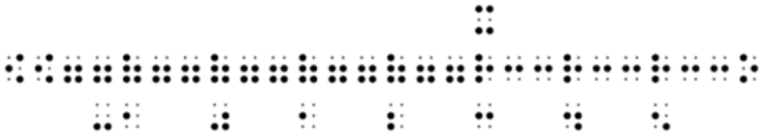
Detailed Example

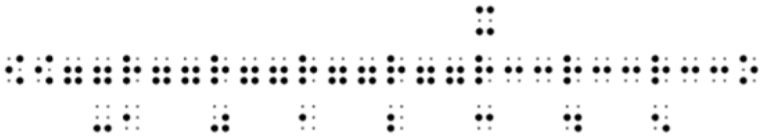
1. Graph $x < 3$ on a number line.



Construct a number line and space it such that you could have at least a couple of coordinates larger than 3 and a few smaller than 3; perhaps label it from -1 through 5, and add an additional left pointing arrowhead (or bold left-pointing arrowhead). Then, braille an open circle (point not included) above the scale mark at coordinate 3. Finally, starting just to the right of the 2nd left-pointing arrow, "shade" the number line all the way up to, but not including, the 3.

You may find it easier to shade on top of scale marks, but transcribers do not as shown in the graphs below. Our examples will be done as a transcriber, since that is the way you will see number lines graphed in a textbook or on a test.


(student)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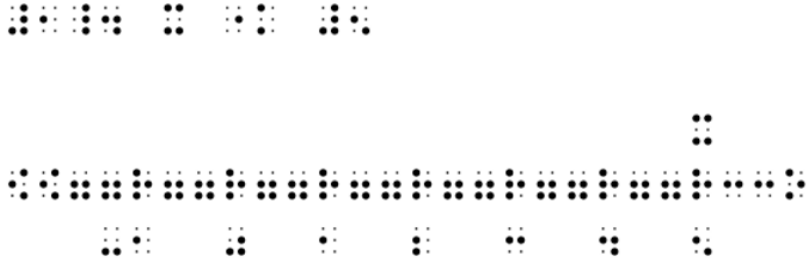
Interpreting Inequalities on a Braille Number Line Graph

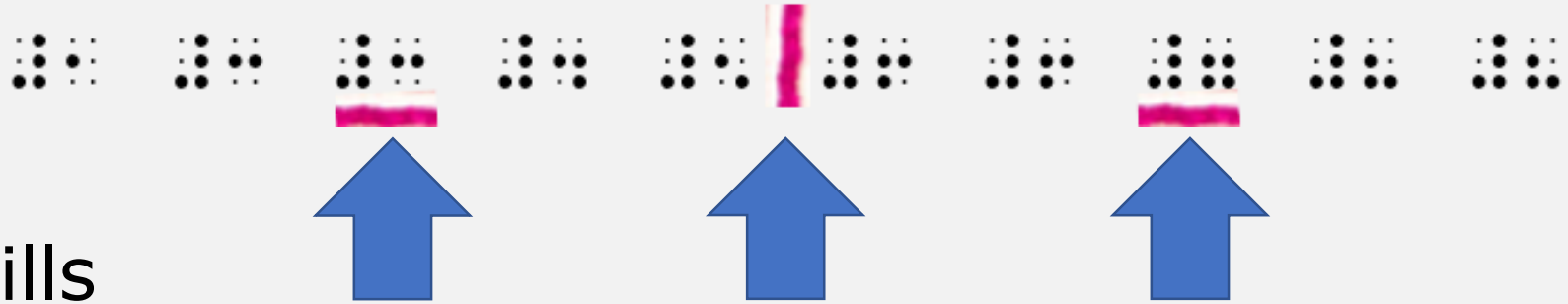
Activity 1b Answer Key

Insert these sheets into your braillewriter and label the inequality graphed on each number line just to the right of the problem number.

Answer: 1. $x < 5$



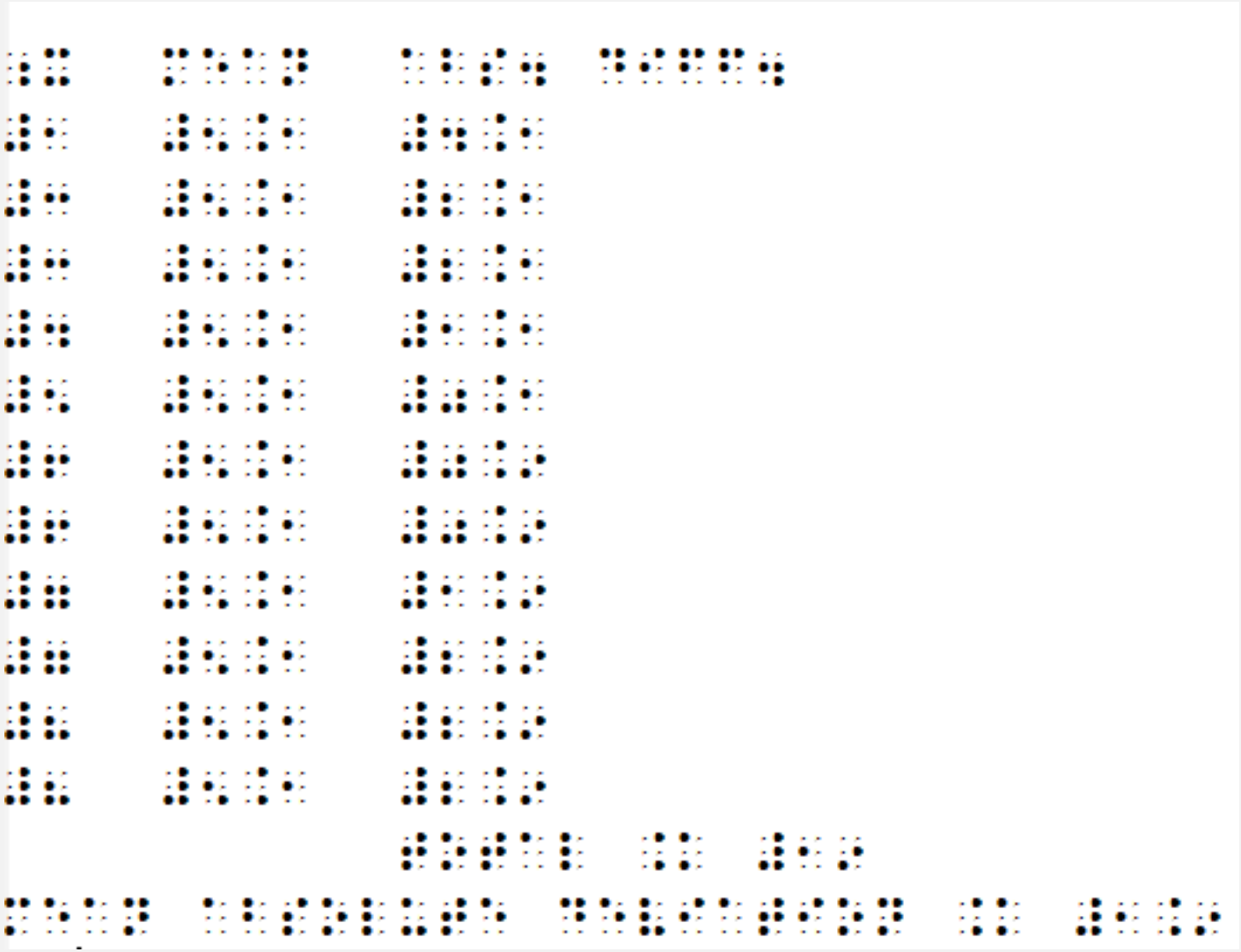
Statistics



- 6th – 7th grade skills
- Concepts/terminology:
  - Mean – average (use calculator)
  - Median – put in order and find the middle (use braille writer)
  - Mode – most common (inspection)
  - Quartile – put in order and put numbers in 4 groups (use braille writer and WikkiStix)
  - Interquartile range: difference between Q1 and Q3

Mean Absolute Deviation

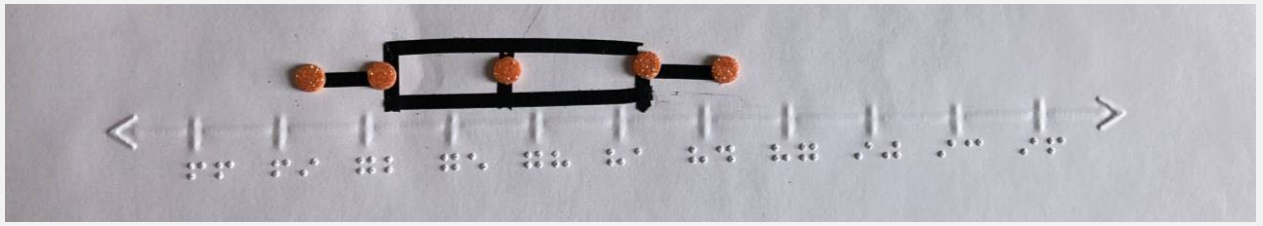
- 6th – 7th grade skill
- Students use a braille writer and calculator.
  - 1st column – numbers in list
  - 2nd column – mean or average
  - 3rd column – subtract columns and take absolute value
  - Find mean or average of last column



Box and Whisker Plot Data Set

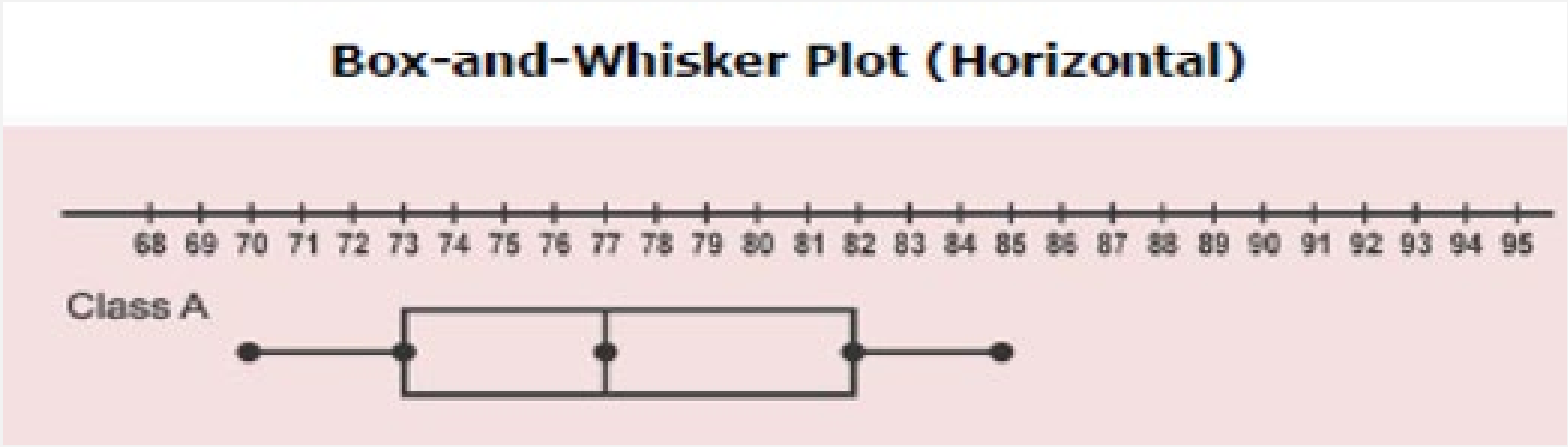
- Box and whisker plots can be used to represent data sets graphically.
- Let’s look at a data set with:
  - A minimum of 70
  - Q1 of 73
  - Median (Q2) of 77
  - Q3 of 82
  - A maximum of 85

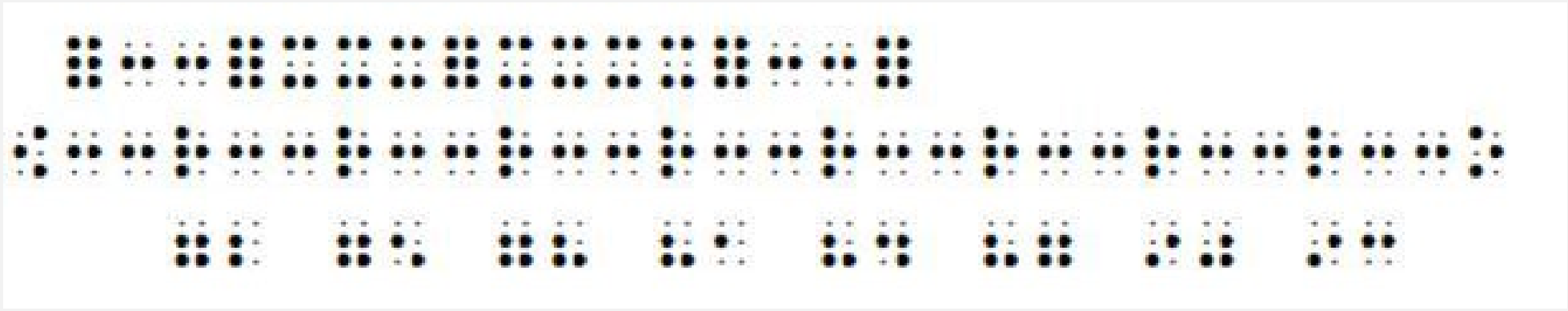
Box and Whisker Plot



- 6th grade skill
- Some different ways students can represent box and whisker plots (Feel free to be creative here.)
- The key is for the student to have the horizontal values on a number line, dots to represent the 5 key points, and something thicker to represent the boxed areas. Examples:
  - Braillewriter
  - Pre-made tactile number line, tactile dots, and graphic art tape, or WikkiStix
  - Graph paper, feel and peel square stickers, and tactile dots to lay the box and whisker plot out horizontally.

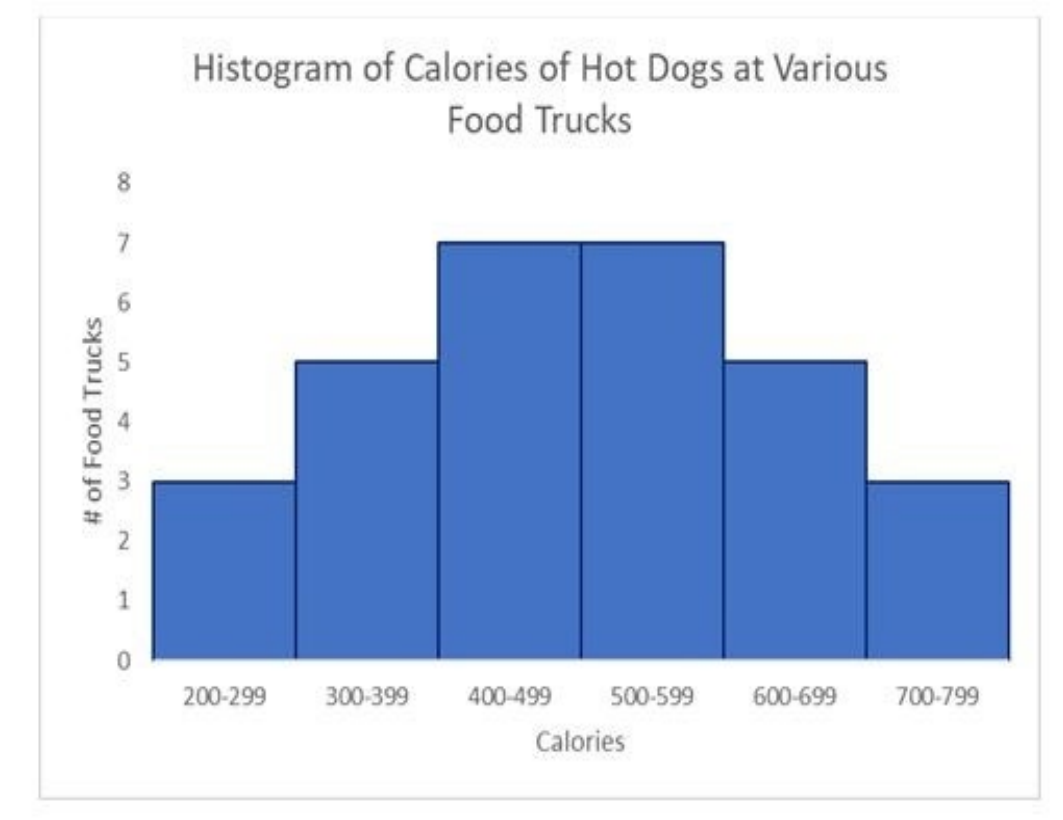
Box and Whisker Plot on Braillewriter



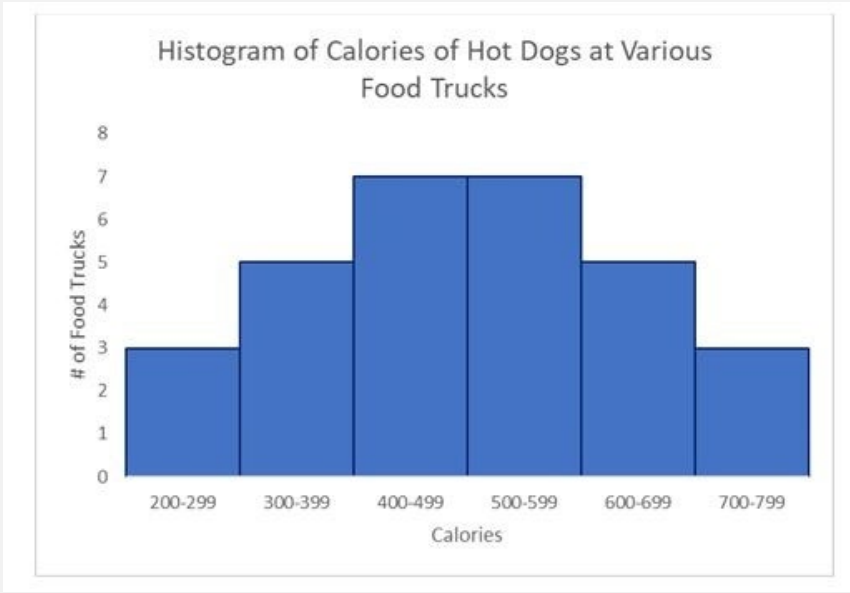


Histogram

- 6th grade skill
- Consider decreasing the number of histograms students must produce, focus more on having student read and understand histograms than construct.
- Ways students can create histograms, though not quick
  - Tactile graph paper and stickers
  - Braille writer as a horizontal histogram using full cells for bars.



Histogram with Braille Writer by Student



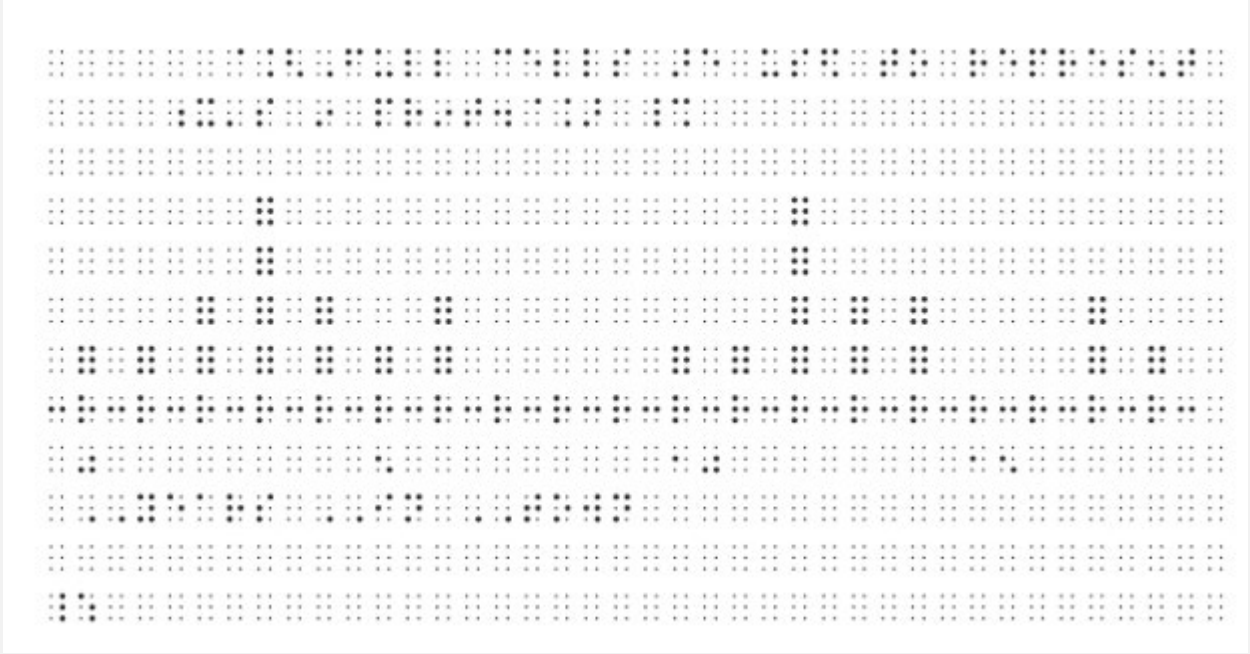
Dot Plots, Also Called Line Plots

- 6^{th} – 7^{th} grade skill
- Line plots are a series of dots or x’s above a number line.
- Use
  - Use number lines and full cells for the dots or x’s above the number line.
  - Use consumable number lines glued to braille paper and stickers for x’s.

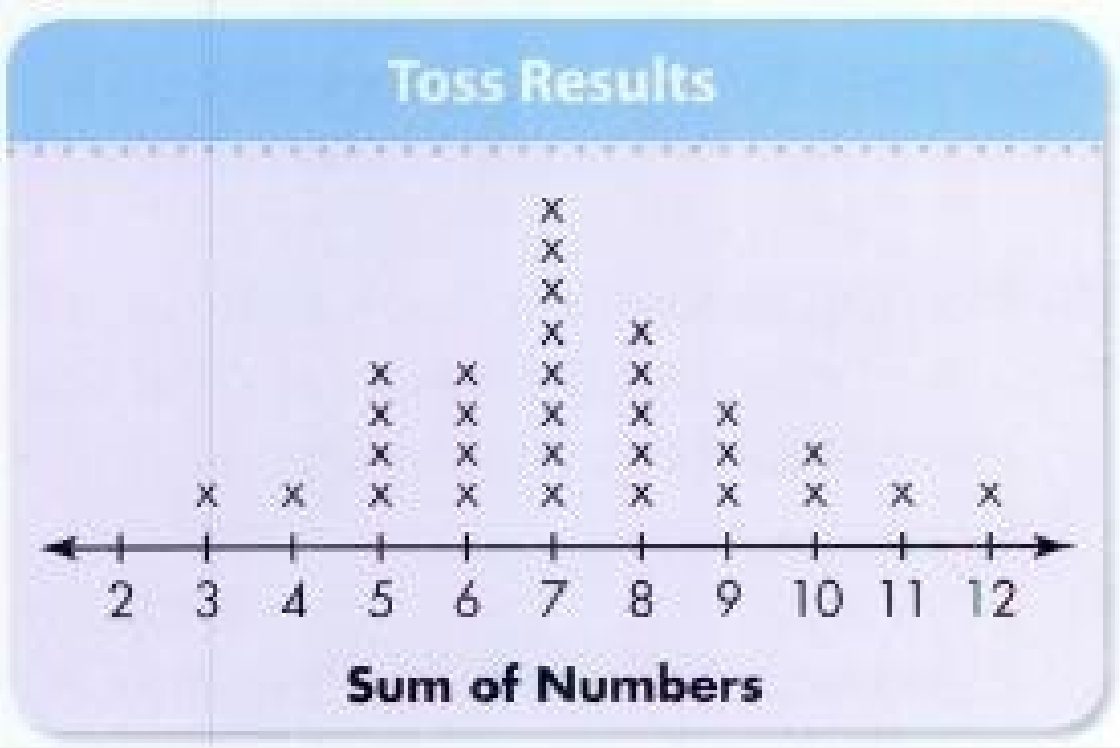
Line Plot Example 1

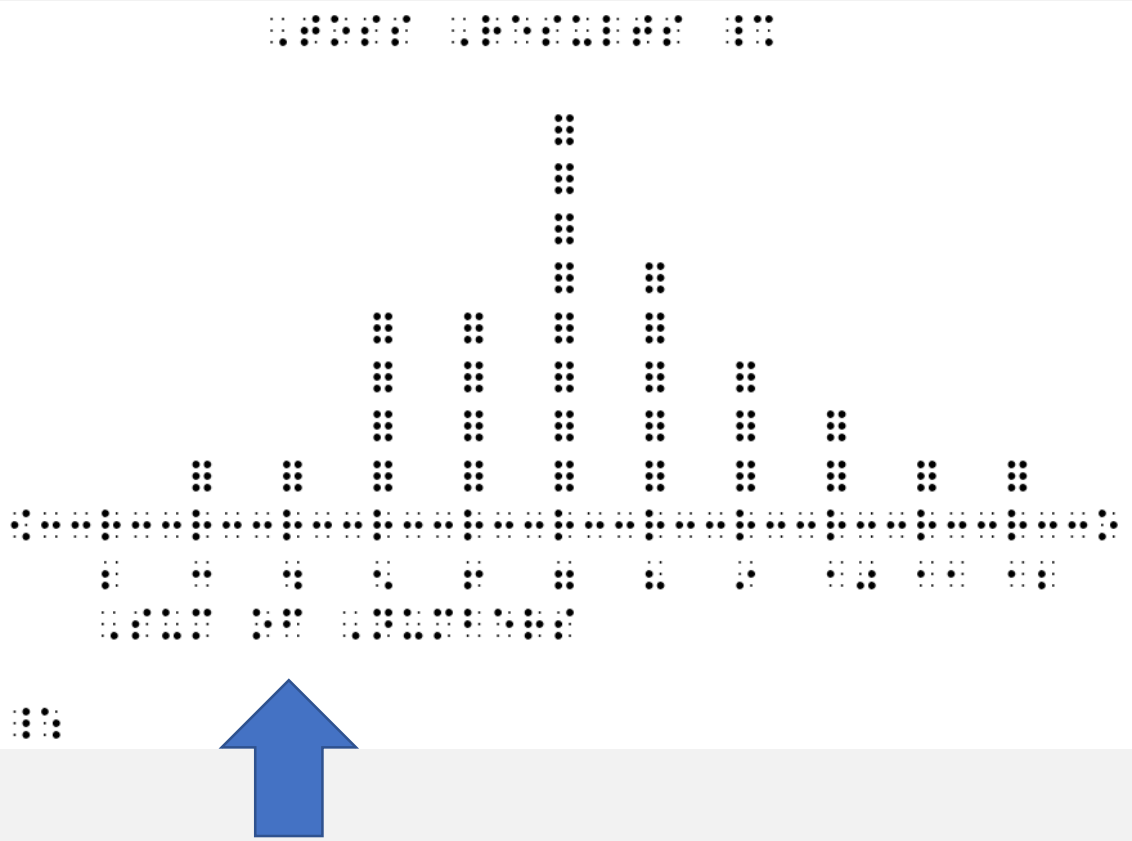
Transcriber's Note:

Full cells are used to represent x's in print.



Line Plot Example 2

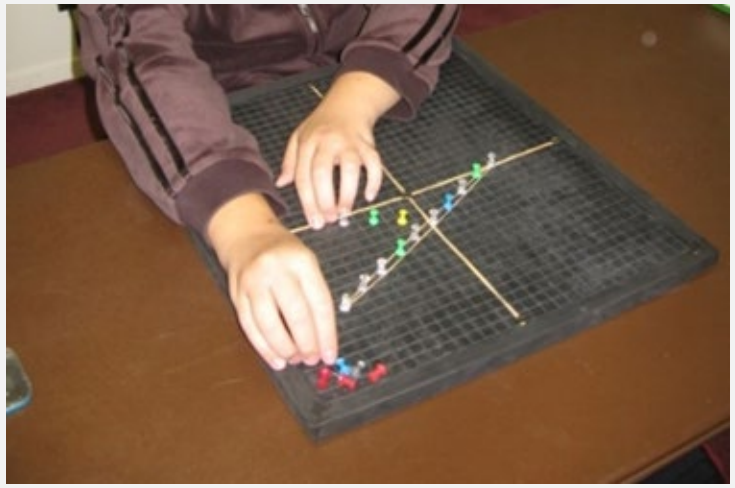


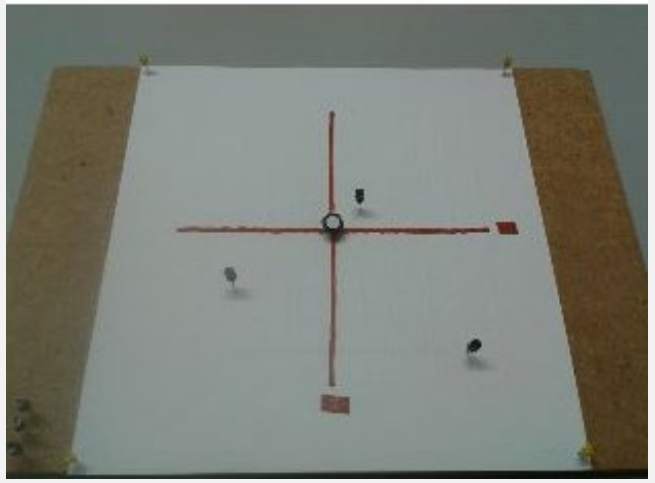


No contractions within Nemeth Code switch indicators.

Coordinate Plane

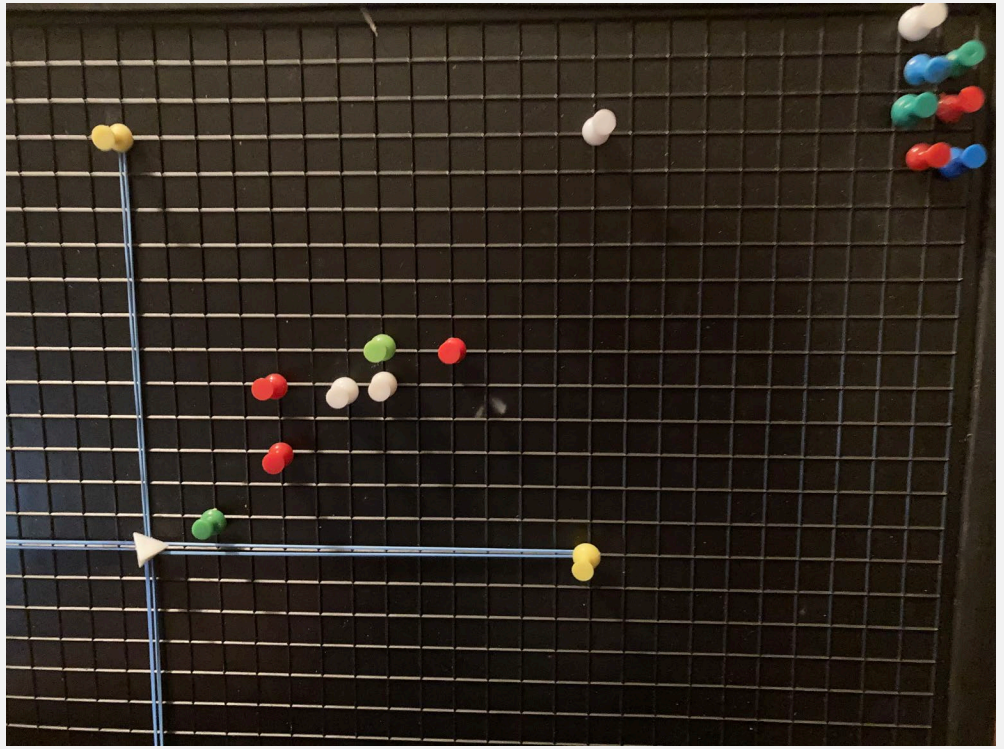
- Starting in 6th grade
- Concepts/terminology:
  - Origin
  - Four quadrants (labeled with Roman numerals)
  - Axes
  - Distance when the x- or y-coordinate are the same
- Use
  - APH Graphic Aid for Mathematics
  - Tactile graph paper on corkboard





Scatter Plot

- 8th grade skill
- Concepts/terminology
  - Clustering: points close together
  - Outliers: points far away from the rest of the points
  - Positive correlation: points rising as they go to the right
  - Negative correlation: points falling as they go to the right
  - Linear: points in a straight line
  - Nonlinear: points not in a straight line



It is important to have the origin be a different type of tack or push pin.

Linear equations

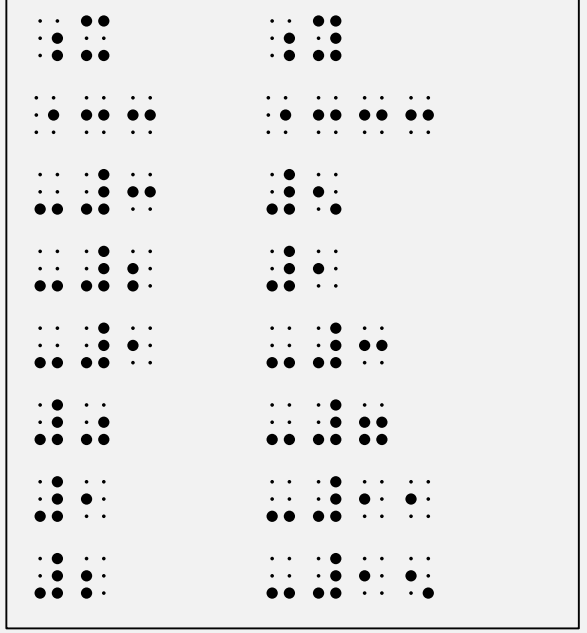
$$y = -\frac{1}{3}x + 2$$

- 8th grade skill
- Visual – draw lines to connect points
- Tactual – rubber band to connect points
- Concepts/terminology
  - Equation y=mx+b
  - Slope is “m” in the equation and y-intercept is “b”
  - Slope/rate of change using a graph student has to count up and over to the next point
  - y-intercept using a graph: the place where the line crosses the y-axis

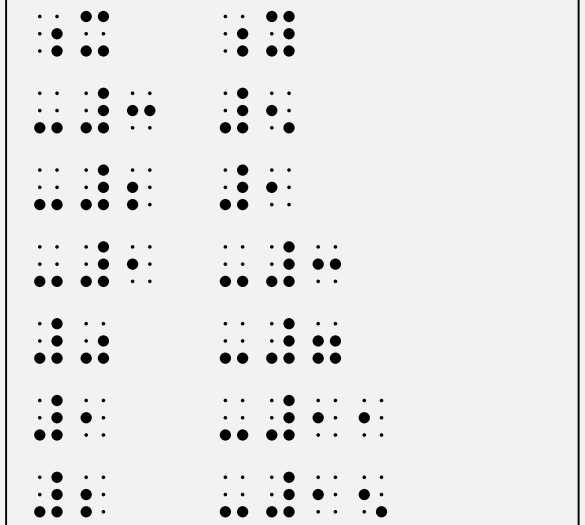
Table of Values

- 6th grade skill
- Concepts/terminology
  - x-coordinate
  - y-coordinate
- Use
  - Braille writer
- Transcriber vs. Student

Transcriber

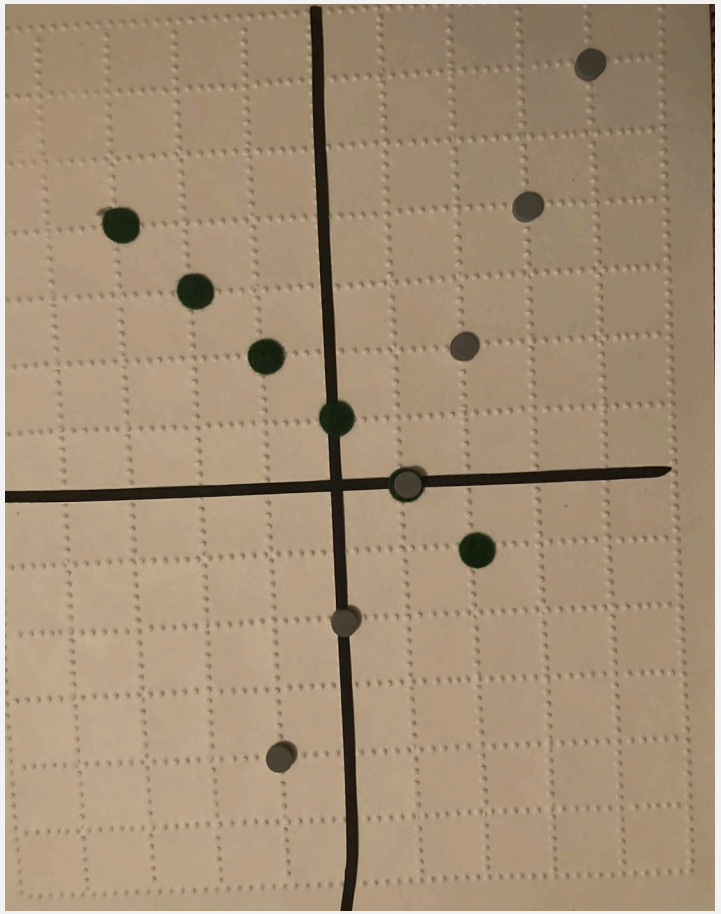


Student



Graphs for Systems of Equations

- 8th grade skill
- Use:
  - Graphic Aid for Mathematics (use two types of push pins or tacks)
  - Tactile graph paper and dots (use two distinct types of dots)
- Types
  - Intersection – one solution
  - Same line – infinitely many solutions
  - Parallel – no solution



$$x + y = 1$$
$$2x - y = 2$$

Systems of Equations Solved Algebraically

- 8th grade skill
- Students need to use the braille writer, not a notetaker!
- This type of problem requires the student to view the two lines at the same time.

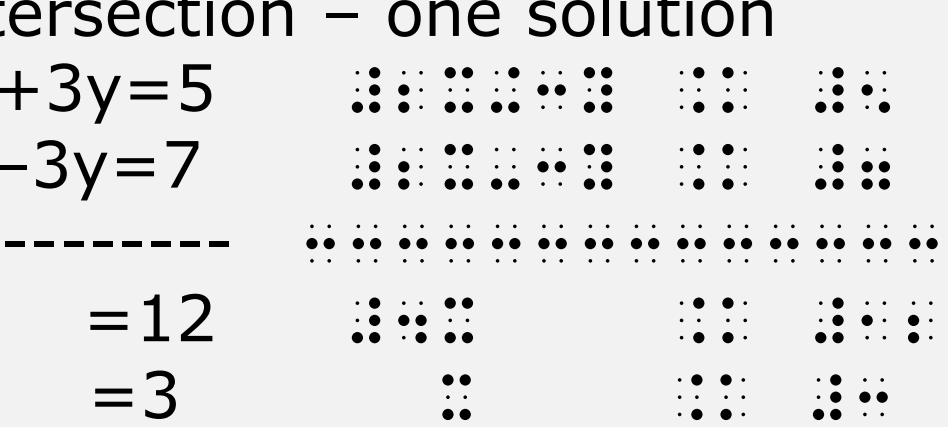
Intersection – one solution

2x+3y=5

2x–3y=7

4x =12

x =3



Systems of Equations Solved Algebraically - Continued

Parallel – no solution

$$\begin{array}{r} 2x+3y=5 \\ -2x-3y=-8 \\ \hline 0=-3 \end{array}$$

Same line – infinitely many solutions

$$\begin{array}{r} 2x+3y=5 \\ -2x-3y=-5 \\ \hline 0=0 \end{array}$$

Graphing Calculator

- Orion TI-84 Plus Graphing Calculator

http://www.orbitresearch.com/product/orion-ti-84-plus/

- Desmos Graphing Calculator

https://www.desmos.com/calculator

$$y = -\frac{1}{2}x + 3$$

$$y = x - 3$$

Radical Lessons from Pearson

- 6^{th} – 8^{th} grade skills
- The Pearson radical curriculum includes:
  - Radical expressions
  - Radical expressions with an index
  - Adding and subtracting radical expressions
  - Multiplying and simplifying radical expressions
  - Division with radical expressions

https://accessibility.pearson.com/resources/nemeth-curriculum/grades-three-eight/

Reading and Writing Radical Expressions, Lessons from Pearson

Reading

1. $\sqrt{25}$ would be read: the square root of twenty-five.

2. $\sqrt{x}$ would be read: the square root of x.

3. $\sqrt{\frac{1}{4}}$ would be read: the square root of one-fourth.

4. $\sqrt{0.49}$ would be read: the square root of zero point four nine.

Writing

Write the following square roots. Also, number each problem.

1. $\sqrt{36}$ the square root of thirty-six

Answer: 

2. $\sqrt{y}$ the square root of y

Answer: 

3. $\sqrt{\frac{1}{9}}$ the square root of one-ninth

Answer:

Preparing the Student for High School

- Understanding the roles of adults involved in their education
- Reducing dependency on paraprofessionals
- Developing self-advocacy skills
- Being responsible for their own decisions and the natural consequences
- Learning to be an effective problem-solver

The Reality in Middle School Math Class

- Adults must refrain from the “magic fairy syndrome”.
- Students need to know where materials are kept and are responsible for getting and putting back materials.
- By middle school, fewer manipulatives are used.

Ideas for Organization of Workspace and Materials

- Students need to develop an organizational system and adults and classmates need to respect the system.
  - Milk crates with hanging folders (e.g., 1 inch graph paper)
  - Container/bags with tactile dots, graphics tape etc.
  - Tackle box/craft containers to organize materials
  - Spiral bound index cards with braille-print numbers to use to label things they have done they are taking a photo of.