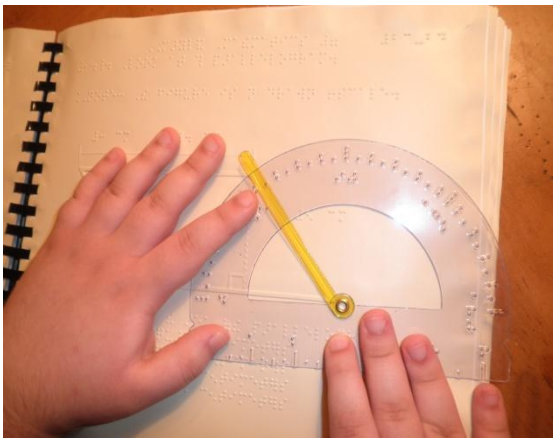

Figure 1 Student Using a Braille Protractor To Measure an Angle in a Braille Mathematics Textbook

Maryland Common Core State Curriculum Frameworks for Braille

Mathematics

Maryland State Department of Education
2012

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Introduction

Literacy, a basic requirement for full participation in social and economic life, includes the ability to read, write, and compute. Students who are blind or visually impaired must have the same access as sighted students to all standards, curriculum, and instruction in order to achieve essential literacy levels, attain high academic expectations, and become productive citizens. During the 2010 Maryland Legislative Session, House Bill 413 and Senate Bill 230 were passed "to establish standards for mastery of braille for use in instruction in certain subjects for blind or visually impaired students" (Annotated Code of Maryland, Section §8-408, 2010). To achieve successful implementation of these standards for mastery of braille, House Bill 413 and Senate Bill 230 both require the Maryland State Board of Education and the Professional Standards and Teacher Education Board to "review and, as appropriate, modify certain certification and recertification requirements for certain teachers; and generally relating to the use of braille for instruction of blind or visually impaired students" (Annotated Code of Maryland, Section §8-408, 2010). As part of this implementation, the Maryland State Department of Education (MSDE) formed the Maryland Braille Task Force to develop standards for the mastery and application of braille skills needed at each grade/course level.

Members of the Maryland Braille Task Force represent a broad range of stakeholder groups, including:

- parents of students who are blind or visually impaired;
- classroom teachers and administrators from The Maryland School for the Blind;
- teachers of the blind and visually impaired;
- braille transcribers;
- orientation and mobility (O&M) specialists;

- the Maryland Chapter of the National Federation of the Blind;
- the Maryland's Parents of Blind Children; and
- the Maryland State Department of Education, the Division of Instruction and the Division of Special Education/Early Intervention Services.

The process used by the Task Force was just as important as the task of creating the *Maryland Common Core State Curriculum Frameworks for Braille: Mathematics.* Decisions were made using consensus building, and meetings were facilitated by a trained facilitator from the Mid-South Regional Resource Center to ensure fidelity to a process based on respectful discussions, effective resolution of any conflicts, and completion of the task.

The Task Force met six times during the 2010-2011 school year and three times during the 2011-2012 school year to develop braille standards for Mathematics. The members reviewed the Maryland State Curriculum, the Maryland Core Learning Goals, the National Common Core State Standards, the Maryland Common Core State Curriculum Frameworks, similar braille standards from other states, curriculum checklists, and other resources. Standards for grades Prekindergarten through five were completed first, followed by middle school grades and high school courses.

The Task Force members shared common beliefs, which guided the development of this document:

- ***The document should promote strong skills and high, measurable, academic expectations by establishing grade level standards for students who read braille in grades prekindergarten through twelve.***
- ***The document must reflect the same expectations of meeting grade level standards for student who read braille as for their sighted peers.***

- ***The document needs to be useful and relevant, have a strong connection to general education, and be a model of accessibility.***
- ***The Nemeth Code for Mathematics and Science is the standard code for representing mathematical and scientific expressions in braille. A thorough understanding of the Nemeth Braille Code by students is essential for success in mathematics.***
- ***The Guidelines and Standards for Tactile Graphics provide standardization for conveying graphical material into transformed representations adapted for students who read Braille and students who read braille must be skilled in interpretation and construction of mathematical tactile graphics.***
- ***High expectations in the use of braille and tactile graphics to access core curriculum content will lead to success on future state assessments in mathematics, as well as the current Maryland School Assessment, High School Assessment, Modified High School Assessment, and Alternate Maryland School Assessment.***
- ***High expectations in the use of braille and tactile graphics to access core curriculum content will help ensure that students who are blind or visually impaired are college and/or career ready.***

The intent of the *Maryland Common Core State Curriculum Frameworks for Braille: Mathematics* is to identify the specific braille and tactile graphics skills needed to access the general education curriculum, not to dilute in any way the rigor of the *Maryland Common Core State Curriculum Frameworks*. Thus, this document embeds the braille and tactile graphics necessary to: (1) access the *Maryland Common Core State Curriculum Frameworks* at each specific grade/course level for ease of use; (2) encourage vertical and horizontal discussions regarding standards, curriculum, and instruction; and (3) provide guidance on grade-level expectation for students who read braille to the

intended audience: teachers of the blind and visually impaired, general and special education teachers, related vision service providers (for example, O&M specialists, braille transcribers, paraprofessionals), and school-, district-, and state-level administrators, and parents. This document is not intended to be an instructional guide with strategies or procedures for teaching a braille reader. It is a framework for equal, grade-level expectations of the braille skills needed to access the general education curriculum. Additional materials, resources, and professional development are needed to promote effective instructional practices.

The Task Force members noted the use of technology to supplement mathematics instruction. This technology includes software, hardware, and web-based programs. Most current technologies that would be used for mathematics instruction are not accessible to blind and visually impaired students nor have accessible equivalents. With the conviction that equitable, accessible technology must be developed in order for blind and visually impaired students to have complete access to challenging mathematics instruction at all levels, Task Force members are calling on advocates and technology developers to not only recognize this need, but to remedy the inequity.

This document was formatted to ensure accessibility and relevance for the intended audience. Accessibility was incorporated by using style sheets, labeled and separate tables, and larger and clearer fonts. Braille skills added to the standards are underlined so they are visible to sighted users and auditorily distinct for users who are blind using screen reading software. The document also includes several appendices: charts of braille and tactile graphics for mathematics by grade levels and courses using simulated braille, a list of acronyms and definitions, and a list of resources and materials to assist in implementation. The document is available in both PDF and Microsoft Word formats.

In order to view the simulated braille in the Word format, one must download free braille fonts and install them in the fonts' folder. Fonts can be downloaded at: http://duxburysystems.com/product2.asp?product=The%20Braille%20TrueType%20Fonts&level=free&action=pur

In addition to creating the *Maryland Common Core State Curriculum Frameworks for Braille: Mathematics*, the Task Force members reviewed current Maryland certification and recertification requirements for teachers of students who are blind and visually impaired. Moreover, the members suggested revisions to the MSDE, based upon current higher education course offerings, best practices in the field, and the work of the Task Force.

To conclude, the Task Force members recommend that this document be disseminated to the intended audience of stakeholders noted above for awareness, professional development, and implementation. The *Maryland Common Core State Curriculum Frameworks for Braille: Mathematics* provides the resources to help ensure that students who are blind or visually impaired can achieve equal access and high expectations with the same rigorous content as all students. In the words of Dr. Abraham Nemeth, inventor of the Nemeth Braille Code for Mathematics and Science, "The most important thing is to expect from a blind child what you expect from a sighted child. Don't lower your standards because the child is blind. Expect the child to live up to his/her potential." (Kapperman, Heinze, & Sticken, 1997)

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Maryland Common Core State Curriculum Frameworks for Braille

How to Read the Maryland Common Core Curriculum Framework for Braille: Mathematics

This framework document provides an overview of the Standards that are grouped together to form the Domains. The Standards within each domain are grouped by topic and align to the order of the Common Core Kindergarten Standards for Mathematics. This document is not intended to convey the exact order in which the Standards will be taught, nor the length of time to devote to the study of the different Standards.

The framework contains the following**:**

- **Domains** are intended to convey coherent groupings of content.
- **Clusters** are groups of related standards**.** A description of each cluster appears in the left column.
- **Standards** define what students should understand and be able to do.
- **Essential Skills and Knowledge** statements provide language to help teachers develop common understandings and valuable insights into what a student must know and be able to do to demonstrate proficiency with each standard. Maryland mathematics educators thoroughly reviewed the standards and, as needed, provided statements to help teachers comprehend the full intent of each standard. The wording of some standards is so clear, however, that only partial support or no additional support seems necessary.
- **Standards for Mathematical Practice** are listed in the right column.

Formatting Notes

- ***Black*** *– words/phrases from the Common Core State Standards Document*
- ***Purple bold*** *– strong connection to current state curriculum for this course*
- ***Red Bold****- items unique to Maryland Common Core State Curriculum Frameworks*
- ***Blue bold*** *– words/phrases that are linked to clarifications*
- ***Green bold*** *– standard codes from other courses that are referenced and are hot linked to a full description*
- *Underlining – word/phrases/sentences that pertain to braille reading, writing, mathematics, and tactile graphics*
- *~~Strikethroughs~~ - word/phrases that are visual in nature and not applicable to a student who reads braille*

Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

1. Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4. Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying

assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well-remembered 7 × 5+ 7 × 3, in preparation for learning about the distributive property. In the expression x^2 + 9*x* + 14, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5-3\ x-y\ ^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers *x* and *y*.

8. Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation (*y* – 2)/(*x* – 1) = 3. Noticing the regularity in the way terms cancel when expanding (*x* – 1)(*x* + 1), $(x-1)(x^2+x+1)$ and $x-1\quad x^3+x^2+x+1$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Connecting the Standards for Mathematical Practice to the Standards for Mathematical Content

The Standards for Mathematical Practice describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle and high school years. Designers of curricula, assessments, and professional development should all attend to the need to connect the mathematical practices to mathematical content in mathematics instruction. The Standards for Mathematical Content are a balanced combination of procedure and understanding. Expectations that begin with the word "understand" are often especially good opportunities to connect the practices to the content. Students who lack understanding of a topic may rely on procedures too heavily. Without a flexible base from which to work, they may be less likely to consider analogous problems, represent problems coherently, justify conclusions, apply the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices. In this respect, those content standards which set an expectation of understanding are potential "points of intersection" between the Standards for Mathematical Content and the Standards for Mathematical Practice. These points of intersection are intended to be weighted toward central and generative concepts in the school mathematics curriculum that most merit the time, resources, innovative energies, and focus necessary to qualitatively improve the curriculum, instruction, assessment, professional development, and student achievement in mathematics.

Codes for Maryland Common Core State Curriculum: Mathematics

Standards for Prekindergarten – 12

Grades Prekindergarten – 8		**Applicable Grades**
CC	Counting & Cardinality	PreK, K
EE	Expressions & Equations	6, 7, 8
F	Functions	8
G	Geometry	PreK, K, 1, 2, 3, 4, 5, 6, 7, 8
MD	Measurement & Data	PreK, K, 1, 2, 3, 4, 5
NBT	Number & Operations (Base Ten)	PreK, K, 1, 2, 3, 4, 5
NF	Number & Operations (Fractions)	3, 4, 5
NS	Number System	6, 7, 8
OA	Operations & Algebraic Thinking	PreK, K, 1, 2, 3, 4, 5
RP	Ratios & Proportional Relationships	6, 7
SP	Statistics & Probability	6, 7, 8
High School		
Algebra (A)		
A-APR	Arithmetic with Polynomial & Rational Expressions	9 -12
A-CED	Creating Equations	9 -12
A-REI	Reasoning with Equations & Inequalities	9 -12
A-SSE	Seeing Structure in Expressions	9 -12
Functions (F)		
F-BF	Building Functions	9 -12
F-IF	Interpreting Functions	9 -12
F-LE	Linear, Quadratic & Exponential Models	9 -12
F-TF	Trigonometric Functions	9 -12
Geometry (G)		
G-C	Circles	9 -12
G-CO	Congruence	9 -12
G-GMD	Geometric Measurement & Dimension	9 -12
G-MG	Modeling with Geometry	9 -12
G-GPE	Expressing Geometric Properties with Equations	9 -12
G-SRT	Similarity, Right Triangles & Trigonometry	9 -12
Number and Quantity (N)		
N-CN	Complex Number System	9 -12
N-Q	Quantities	9 -12
N-RN	Real Number System	9 -12
N-VM	Vector & Matrix Quantities	9 -12
Statistics and Probability (S)		
S-ID	Interpreting Categorical & Quantitative Data	9 -12
S-IC	Making Inferences & Justifying Conclusions	9 -12
S-CP	Conditional Probability & Rules of Probability	9 -12
S-MD	Using Probability to Make Decisions	9 -12
Modeling		
Noted by ★		9 -12

PREKINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
Know number names and the count sequence.	**Standard: PK.CC.1** Count verbally to 10 by ones. **(SC PK)** **Essential Skills and Knowledge** • **Ability to use rote counting number words in order** • **Ability to use Verbal counting as meaningful counting to solve a problem, such as finding out how many are in a set** **Standard: PK.CC.2** Recognize the concept of just after or just before a given number in the counting sequence up to 10 using Nemeth Braille Code numbers **Essential Skills and Knowledge** • **Ability to use concrete materials and/or adapted number cards arranged in a line to count and then determine what number comes before or away a specific number** • **Students are not expected to write numerals at this time.** **Standard: PK.CC.3** Recognize written Nemeth Braille Code numerals 0-10. **Essential Skills and Knowledge** • **Ability to match written numerals in Nemeth Braille Code with concrete representations** • **Students are not expected to write numerals at this time.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**

PREKINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
Count to tell the number of objects.	**Standard PK.CC4:** Understand the relationship between numbers and quantities to 5, then to 10; connect counting to cardinality. **Essential Skills and Knowledge** • **See the Skills and Knowledge listed for Standards PKCC4a-c to apply to standard.** **Standard: PK.CC.4a:** When counting objects, say the number names in the standard order, pairing each object with one and only one number name. **Essential Skills and Knowledge** • **Ability to apply the strategies of touching objects as they are counted and by organizing the objects in a row** • **Knowledge of and ability to apply one-to-one correspondence when counting** **Standard: PK.CC.4b:** Recognize that the last number name said tells the number of objects counted. **Essential Skills and Knowledge** • **Ability to use one-to-one correspondence when counting objects** • **Ability to answer "how many" after counting the objects in a set (beginning cardinality understanding)** • **Ability to recognize that the quantity remains the same regardless of the arrangement or change in order**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**

PREKINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
	Standard: PK.CC.4c: Recognize that each successive number name refers to a quantity that is one larger. **Essential Skills and Knowledge** • **Ability to build and compare sets that increase by one** • **Ability to use concrete materials and 0-10 tactile graphic of a number line** • **Beginning knowledge of the relationships between numbers (patterns) which will lead to long-term understanding of counting cardinality** **Standard: PK.CC.5** Represent a number (0-5, then to 10) by producing a set of objects with concrete materials, tactile graphics of pictures represented by simple, solid shapes (circles, squares, triangles), and/or Nemeth Braille Code numerals (with 0 representing a count of no objects). **Essential Skills and Knowledge** • **Ability to build sets with concrete materials to show a given amount** • **Students are not expected to write the numerals at this time** • **Ability to represent sets with drawings using real objects/manipulatives/tactile drawing tools/braille writer which will lead to the ability to subitize** • **Knowledge of the relationship between counting and quantity** • **Ability to match sets with numerals, and create sets to match numerals, up to five, then to ten**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**

PREKINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
	• **Knowledge of an ability to use of regular configurations/structured sets especially when working with larger numbers. Ability to use varied configurations and representations with smaller numbers** **Standard: PK.CC.6** Recognize the number of objects in a set without counting aloud by tactually exploring systematic layouts of objects (**Subitizing**). (Use 0-5 objects) **Essential Skills and Knowledge** • **See the skills and knowledge as stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for regularity in repeated reasoning.**
Compare quantities.	**Standard: PK.CC.7** Explore relationships by comparing groups of objects up to 10, to determine greater than/more or less than, and equal to/same **(SC PK)** **Essential Skills and Knowledge** • **Ability to compare sets ~~visually~~ tactually and/or by matching the sets using one-to-one correspondence** • **Knowledge of the terms "greater than/more than", "less than", and "equal to/same" through experiences with comparing groups of objects (e.g., "There are more boys than girls.")** • **Ability to identify which number comes later in the counting sequence when counting two sets of objects**	

PREKINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
	Standard: PK.CC.8 Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies (includes groups with up to 5 objects). **Essential Skills and Knowledge** • **Ability to compare two sets, by matching and counting objects** • **Ability to compare sets numerically** • **Ability to use the terms "greater than/more than", "less than", and "equal to/same" (e.g., "There are more boys than girls because there are 5 boys and 2 girls".)** • **Ability to know that when a set has more than another set, the number that represents its quantity comes later in the counting sequence that the number that represents the smaller set**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**

PREKINDERGARTEN

Domain: Operations & Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.	**Standard: PK.OA.1** Explore addition and subtraction with objects, fingers, mental images, drawings[1] (tactile graphics and tactile drawing tools), sounds (e.g., claps), acting out situations, or verbal explanations. **Essential Skills and Knowledge** • **Knowledge that "Putting together" and "adding to" are two different processes of addition** • **Knowledge that "Taking apart" and "taking from" are two different processes of subtraction** • **Ability to use actual, physical objects to represent the problem when working on a solution (e.g., dinosaur toys to represent dinosaur problem, sticker represent stickers, fingers represent fingers)** • **Ability to use "Math manipulative" to represent the objects (e.g., unifix cubes may represent foods, two-sided counters may represent animals) when working on a solution** • **Ability to use tactile graphics of pictures either drawn by teacher and/or by student to solve the problem (Student drawings need not show details, but should show the mathematics in the problem.)** • **Ability to use visualization and/or mental strategies of the problem to arrive at a solution** • **Students are not expected to write equations in Prekindergarten**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**

PREKINDERGARTEN

Domain: Operations & Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	Standard: PK.OA.2 Decompose quantity (less than or equal to 5, then to 10) into pairs in more than one way e.g., by using objects or drawings (tactile graphics and tactile drawing tools/braille writer). **Essential Skills and Knowledge** • **Ability to manipulate sets to explore decomposition of number rather than working on 5 = 3 + 2.** **Standard: PK.OA.3** For any given quantity from (0 to 5, then to 10) find the quantity that must be added to make 5, then to 10, e.g., by using objects or drawings (tactile graphics and tactile drawing tools/braille writer). **Essential Skills and Knowledge** • **Ability to use manipulatives to find the amount needed to complete the set**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for regularity in repeated reasoning.**

PREKINDERGARTEN

Domain: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
Work with numbers 0-10 to gain foundations for place value.	**Standard: PK.NBT.1** Investigate the relationship between ten ones and ten. **Essential Skills and Knowledge** • **Ability to explore ten ones in various ways using manipulatives (e.g., Digi-Blocks, base ten blocks, linking cubes.)** • **Knowledge of how ten ones makes a ten is the initial foundation of place value**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**

PREKINDERGARTEN

Domain: Measurement & Data		
Cluster	**Standard**	**Mathematical Practices**
Describe and compare measureable attributes.	**Standard: PK.MD.1** Describe measurable attributes of objects, such as length or weight. **(SC PK)** **Essential Skills and Knowledge** • **Ability to use vocabulary specific to measurable attributes of objects** **Standard: PK.MD.2** Directly compare two objects with a measurable attribute in common, using words such as longer/shorter; heavier/lighter; or taller/shorter. **Essential Skills and Knowledge** • **Knowledge of length/weight as absolute descriptors** • **Ability to physically align two objects to determine which is longer, shorter, or if they are the same length** • **Ability to physically align two objects to determine which is taller, shorter, or if they are the same height** • **Ability to compare the weight of two concrete objects to determine which is heavier, lighter, or if they are the same weight.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**
Sort objects into categories and compare quantities.	**Standard: PK.MD.3** Sort objects into given categories. **Essential Skills and Knowledge** • **See the skills and knowledge as stated in the Standard.**	

PREKINDERGARTEN

Domain: Measurement & Data		
Cluster	**Standard**	**Mathematical Practices**
	Standard: PK.MD.4 Compare categories using words such as *greater than/more, less than, and equal to/same*. **Essential Skills and Knowledge** • **Ability to sort objects into categories and then compare the categories (e.g., There are more bus riders than car riders; or there are the same number of large and small bears.)** • **Ability to compare quantities of the categories ~~visually~~ tactually or by aligning of the items one to one, not by the numeric comparison** • **Knowledge of and ability to apply appropriate comparison vocabulary**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for regularity in repeated reasoning.**

PREKINDERGARTEN

Domain: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Identify and describe two-dimensional shapes (circles, triangles, rectangles; including a square which is a special rectangle).	**Standard PK.G.1:** Match like (**congruent and similar**) manipulatives and tactile graphics of shapes. **Essential Skills and Knowledge** • **Ability to match similar shapes when given various two-dimensional shapes** • **Students do not need to name the shapes or even identify attributes at this time** **Standard PK.G.2:** Group the manipulatives and tactile graphics of shapes by attributes, such as shape, size, texture. **Essential Skills and Knowledge** • **Ability to sort shapes by applying their real-life experiences of sorting by color** • **Knowledge that rectangles and squares may be grouped together as 4-sided figures, which is an important relationship for children to discover** • **Ability to be able to explain their groupings** **Standard: PK.G.3:** Correctly name manipulatives and tactile graphics of shapes (regardless of their orientations or overall size). **Essential Skills and Knowledge** • **Ability to name shapes in varied sizes and orientations** • **Ability to distinguish Examples and non-examples of various shapes**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**

PREKINDERGARTEN

Domain: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Work with three-dimensional shapes to gain foundation for geometric thinking.	**Standard: PK.G.4** Match and sort shapes (real objects/manipulatives). **Essential Skills and Knowledge** • **Knowledge of three-dimensional figures and their relationship to each other and to two-dimensional shapes** • **Students are not expected to name these shapes.** **Standard: PK.G.5** Describe three-dimensional objects using attributes. **Essential Skills and Knowledge** • **Ability to describe three-dimensional objects using vocabulary such as size, shape, labeled color, textures, corners, edges, and/or similarities to other shapes** **Standard: PK.G.6:** Compose and describe structures using three-dimensional shapes. Descriptions may include shape attributes, relative position, etc. **Essential Skills and Knowledge** • **Ability to build structures using manipulatives and blocks** • **Ability to describe their structures including shapes, sizes, comparisons, positional relationships, etc.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for regularity in repeated reasoning.**

KINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
Know number names and the count sequence.	**Standard: K.CC.1** Count to 100 by ones and by tens. **Essential Skills and Knowledge** • **Ability to use rote counting (e.g., simply reciting numbers in order with no meaning attached) to one hundred** • **Ability to use verbal counting (e.g., meaningful counting employed in order to solve a problem, such as finding out how many are in a set.)** • **Ability to use concrete materials to build sets, towers, or groups of ten, to make sense of counting by tens** • **Ability to count with or without manipulatives by ones or tens** • **Ability to count using the braille hundreds chart or tactile graphics of number line** **Standard: K.CC.2** Count forward beginning from a given number within the known sequence (instead of having to begin at 1). **Essential Skills and Knowledge** • **Ability to initially use concrete materials, braille hundreds chart or tactile graphic of a number line to model counting from a given number other than 1** • **Knowledge that counting is the process of adding 1 to the previous number**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

KINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
	Standard: K.CC.3 Write numbers from 0 to 20 using Nemeth Braille Code. Represent a number of objects with a written numeral 0-20 in Nemeth Braille Code (with 0 representing a count of no objects). **Essential Skills and Knowledge** • **Ability to match a set with a braille number card that states its quantity** • **Ability to build numbers with concrete materials and then write the numerals in Nemeth Braille Code that represent those numbers** • **Knowledge that zero represents an empty set**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**
Count to tell the number of objects.	**Standard K.CC.4:** Understand the relationship between numbers and quantities; connect counting to **cardinality**. **Essential Skills and Knowledge** • **Knowledge that cardinality is the understanding that when counting a set, the last number represents the total number of the objects in the set** **Standard: K.CC.4a** When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object. **Essential Skills and Knowledge** • **Ability to apply a one-to-one correspondence when counting**	

KINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
	Standard: K.CC.4b Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted. **(SC K)** **Essential Skills and Knowledge** • **Knowledge of and ability to apply Cardinality (e.g., the understanding that when counting a set, the last number counted represents the total number of the objects in the set)** • **Knowledge of and ability to apply Conservation of number (e.g., ability to understand that the quantity of a set does not change, no matter how the objects of the set are displayed)** • **Ability to apply Subitizing (e.g., the ability to immediately recognize a quantity) when counting objects** **Standard: K.CC.4c** Understand that each successive number name refers to a quantity that is one larger. **Essential Skills and Knowledge** • **Knowledge that when one more is added to a number set, this new number includes all the previous objects in the set, plus the new one. (e.g., 6+1=7)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

KINDERGARTEN

DOMAIN: Counting and Cardinality		
Cluster	**Standard**	**Mathematical Practices**
	Standard: K.CC.5 Count to answer "how many?" questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration; given a Nemeth Braille Code number from 1-20, count out that many objects. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Compare numbers.	**Standard: K.CC.6** Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies (Include groups with up to ten objects). **(SC K)** **Essential Skills and Knowledge** • **Knowledge of and the ability to apply a solid understanding of cardinality and one-to-one correspondence before beginning to compare sets** • **Ability to use of concrete materials when comparing sets** • **Ability to compare ~~visually~~ tactually, to compare by matching, and to compare by counting** **Standard: K.CC.7** Compare two numbers between 1 and 10 presented as written numerals in Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to apply knowledge of and experience with comparing concrete sets of objects (K.CC.6)**	

KINDERGARTEN

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.	**Standard: K.OA.1** Represent addition and subtraction with objects, fingers, mental images, drawings (using tactile drawing tools/braille writer), sounds (e.g., claps), acting out situations, or verbal explanations, or expressions in Nemeth Braille Code, or equations using Nemeth Braille Code symbols for + - = **Essential Skills and Knowledge** • **Ability to represent addition and subtraction processes in a variety of ways, using concrete materials, tactile graphics of pictures, Nemeth Braille Code numbers, words, or acting it out** • **Knowledge that "putting together" and "adding to" are two different processes of addition** • **Knowledge that "taking apart" and "taking from" are two different processes of subtraction** **Standard: K.OA.2** Solve addition and subtraction word problems, and add and subtract within 10, e.g., by using objects or drawings (tactile graphics and tactile drawing tools/braillewriter), to represent the problem. (Use Nemeth Braille Code symbols for + - =) **(SC K)** **Essential Skills and Knowledge** • **Ability to represent the process of solving various types of addition and subtraction word problems (CCSS, Page 88, Tale 1) within 10 using objects and tactile graphics of drawings to develop number sentences** • **Knowledge of the different types of word problems (e.g., add to, result unknown; take from, result unknown; put together/take apart, total**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

KINDERGARTEN

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	unknown) which lays the foundation for more difficult word problems • **Ability to use concrete materials or tactile graphics of pictures and an adapted Part-Part-Whole Mat to organize the manipulatives and make sense of the problem** **Standard: K.OA.3** Decompose numbers less than or equal to 10 into pairs in more than one way, e.g., by using objects or drawing (tactile drawing tools/braille writer), and record each decomposition by a drawing with tactile drawing tools/braillewriter or equations using Nemeth Braille Code (e.g., 5 = 2 + 3 and 5 = 4 + 1). **(SC K)** **Essential Skills and Knowledge** • **Knowledge that decomposition involves separating a number into two parts and understanding that there is a relationship between the sum of the parts and the whole** • **Knowledge that there are a variety of combinations that represent a given number** • **Ability to begin with the whole when decomposing numbers into pairs.** • **Knowledge that when writing an equation to represent the decomposition of a number, the values on each side of the equal sign are the same (e.g., 7 = 2 + 5)**	**1. problems and persevere in solving them.** **2. Reason abstractly and quantitatively** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

KINDERGARTEN

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	Standard: K.OA.4 For any number from 1 to 9, find the number that makes 10 when added to the given number, e.g., by using objects or tactile graphics of drawings using tactile drawing tools/braille writer) and record the answer with a drawing using tactile drawing tools/braillewriter or writing an equation using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to use experience with KOA3 to make sense of this Standard** **Standard: K.OA.5** Fluently add and subtract within 5 with Nemeth Braille Code equations in a horizontal format. **Essential Skills and Knowledge** • **Ability to apply decomposition knowledge and relationship between addition and subtraction to determine the sum or differences of various problems**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

KINDERGARTEN

DOMAIN: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
Work with numbers 11-19 to gain foundations for place value.	**Standard: K.NBT.1** Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or tactile graphics of drawings using tactile drawing tools /tactile graphics/braille writer, and record each composition or decomposition by a drawing using tactile drawing tools/braille writer or equations in Nemeth Braille Code (such as 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones. **Essential Skills and Knowledge** • **Ability to use concrete materials (e.g., Unifix cubes, snap cubes, Digi-blocks, base ten blocks, etc.) to represent the combination of one ten and ones for each number** • **Ability to record the representations of 11 through 19 in tactile graphics of pictures, Nemeth Braille Code numbers, and/or equations**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

KINDERGARTEN

DOMAIN: Measurement & Data		
Cluster	**Standard**	**Mathematical Practices**
Describe and compare measureable attributes.	**Standard: K.MD.1** Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. **(SC K)** **Essential Skills and Knowledge** • **Ability to use measurement and geometric vocabulary when describing the attributes of objects** **Standard: K.MD.2** Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. *For example, directly compare the heights of two children and describe one child as taller/shorter.* **(SC K)** **Essential Skills and Knowledge** • **See the skills and knowledge stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Classify objects and count the number of objects in each category.	**Standard: K.MD.3** Classify objects into given categories; count the number of objects in each category and sort the categories by count (Limit category counts to be less than or equal to 10.). **(SC K)** **Essential Skills and Knowledge** • **Ability to sort objects by a given attribute** • **Ability to classify objects by predetermined categories related to attributes (e.g., number of sides, number of corners)**	

KINDERGARTEN

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).	**Standard K.G.1** Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as *above, below, beside, in front of, behind, and next to*. **Essential Skills and Knowledge** • **Ability to use geometric vocabulary when describing objects** **Standard: K.G.2** Correctly name manipulatives and/or tactile graphics of shapes regardless of their orientations or overall size. **Essential Skills and Knowledge** • **See the skills and knowledge stated in the Standard** **Standard: K.G.3** Identify manipulatives and/or tactile graphics of shapes as two-dimensional (lying in a plane, "flat") or three-dimensional ("solid"). **Essential Skills and Knowledge** • **Ability to sort a variety of shapes into two- and three-dimensional categories and explain why their sorting is correct**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Analyze, compare, create, and compose shape	**Standard: K.G.4** Analyze and compare two- and three-dimensional manipulatives and/or tactile graphics of shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/"corners") and other attributes (e.g., having sides of equal length). **Essential Skills and Knowledge** • **See the skills and knowledge stated in the Standard**	

KINDERGARTEN

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Analyze, compare, create, and compose shape	**Standard: K.G.5** Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes <u>using tactile drawing tools/braille writer</u>. **Essential Skills and Knowledge** • **See the skills and knowledge stated in the Standard** **Standard: K.G.6** Compose simple shapes to form larger shapes. For example, *"Can you join these two triangles with full sides touching to make a rectangle?"* **Essential Skills and Knowledge** • **Ability to use concrete materials (e.g. pattern blocks, tangrams, and shape models to build composite figures** • **Ability to explain how they composed their shape and name what shapes they used to make the composite shape**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 1

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Represent and solve problems involving addition and subtraction.	**Standard: 1.OA.1** Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, tactile graphics of drawings, and Nemeth Braille Code equations with a symbol for the unknown number to represent the problem. To represent unknown symbols in Nemeth Braille Code, use: • symbol of omission for question mark • double dash for blank line • square shape indicator for box/square Read and write equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator.**(SC 1)** **Essential Skills and Knowledge** • **Ability to represent the problem in multiple ways including tactile graphics of drawings and or objects/manipulatives (e.g., counters, unifix cubes, Digi-Blocks, tactile graphics of number lines)** • **Ability to take apart and combine numbers in a wide variety of ways** • **Ability to make sense of quantity and be able to compare numbers** • **Ability to use flexible thinking strategies to develop the understanding of the traditional algorithms and their processes** • **Ability to solve a variety of addition and subtraction word problems (CCSS, Page 88, Table 1)** • **Ability to use □ using the square**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 1

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	shape indicator or ? using the sign of omission to represent an unknown in an equation **Standard: 1.OA.2** Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, tactile representations of drawings, and equations using Nemeth Braille Code with a symbol for the unknown number to represent the problem. To represent unknown symbols in Nemeth Braille Code use: • symbol of omission for question mark • double dash for blank line • square shape indicator for box/square Read and write equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator. **Essential Skills and Knowledge** • **Ability to add numbers in any order and be able to identify the most efficient way to solve the problem** • **Ability to solve a variety of addition and subtraction word problems (CCSS, Page 88, Table 1)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 1

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Understand and apply properties of operations and relationship between addition and subtraction.	**Standard: 1.OA.3** Apply properties of operations as strategies to add and subtract. (Students need not use formal terms for these properties.) *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10, which equals 12. (Associative property of addition.)* **Essential Skills and Knowledge** • **Knowledge of and ability to use the properties of operations** **Standard: 1.OA.4** Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.* **Essential Skills and Knowledge** • **Ability to connect addition to subtraction (Inverse Operation)** • **Ability to apply the strategy to think addition rather than take away: Rather than 9 - 6 = □, ask how many would you add to six to equal nine?** • **Ability to use concrete models with manipulatives to find the unknown**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 1

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Add and subtract within 20.	**Standard: 1.OA.5** Relate counting to addition and subtraction (e.g., by counting on 2 to add 2). **(SC 1)** **Essential Skills and Knowledge** • **Knowledge of and ability to use addition counting strategies (e.g., Counting All, Counting On, Counting On from the Larger Number) to solve problems** • **Knowledge of and ability to use subtraction counting strategies (Counting Up To, Counting Back From) to solve problems** **Standard: 1.OA.6** Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on, making ten (e.g. 8 + 6 = 8 + 2 + 4, which leads to 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1, which leads to 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1, which equals 13). **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 1

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Work with addition and subtraction equations.	**Standard: 1.OA.7** Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.* **Essential Skills and Knowledge** • **Knowledge that an equal sign represents the relationship between two equal quantities** • **Knowledge that the quantities on both sides of the equation are equal in value** **Standard: 1.OA.8** Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the question true in each of the equations 8 + ? = 11, 5 = ? - 3, 6 + 6 = ?.* To represent unknown symbols in Nemeth Braille Code, use: • symbol of omission for question mark • double dash for blank line • square shape indicator for box/square **(SC 1)** **Essential Skills and Knowledge** • **Ability to represent the problem in multiple ways including drawings and or objects/manipulatives (e.g., counters, unifix cubes, Digi-Blocks, number lines)** • **Ability to take apart and combine numbers in a wide variety of ways** • **Ability to make sense of quantity and be able to compare numbers**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 1

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	• Ability to use flexible thinking strategies to develop the understanding of the traditional algorithms and their processes • Ability to solve a variety of addition and subtraction word problems (CCSS, Page 88, Table 1) • Ability to use □ using the square shape indicator or ? using the sign of omission to represent an unknown in an equation	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

GRADE 1

Domain: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**

Extend the counting sequence.	**Standard: 1.NBT.1**
	
	Count to 120 starting at any number less than 120. In this range, read and write Nemeth Braille Code numerals and represent a number of real or tactile graphics objects with a written numeral in Nemeth Braille Code.
	Essential Skills and Knowledge
	• **Counting:**
	  ○ **Ability to produce the standard list of counting words in order**
	  ○ **Ability to represent one-to-one correspondence/match with concrete materials**
	• **Reading:**
	  ○ **Ability to explore ~~visual~~ tactual representations of numerals, matching a ~~visual~~ tactual representation of a set to a numeral**
	  ○ **Ability to read a written numeral**
	• **Writing:**
	  ○ **Ability to represent numerals in a variety of ways, including ~~tracing numbers~~, repeatedly writing numbers, tactile experiences with numbers (e.g., and making numbers out of clay/candy/stickers, ~~tracing them in the sand, and writing on the white board or in the air)~~**
		1. Make sense of problems and persevere in solving them.
		
		2. Reason abstractly and quantitatively.
		
		3. Construct viable Arguments and critique the reasoning of others.
		
		4. Model with mathematics.
		
		5. Use appropriate tools strategically.
		
		6. Attend to precision.
		
		7. Look for and make use of structure.
		
		8. Look for and express regularity in repeated reasoning.

GRADE 1

Domain: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
Understand place value.	**Standard: 1.NBT.2** Understand that the two digits of a two-digit number in Nemeth Braille Code represent amounts of tens and ones. **(SC 1)** **Essential Skills and Knowledge** • **Ability to use base ten manipulatives (e.g., base ten blocks, Digi-Blocks, Unifix Cubes, ten frames, interlocking base ten blocks) to represent two-digit numbers** • **Knowledge of the connection between numerals, words, and quantities** • **Knowledge that two-digit numbers are composed of bundles of tens and leftover ones** • **Ability to count by tens and ones** **Standard: 1.NBT.2a** Understand the following as a special case: 10 can be thought of as a bundle of ten ones -- called a "ten." **Essential Skills and Knowledge** • **Ability to use base ten manipulatives (e.g., base ten blocks, Digi-Blocks, Unifix Cubes, ten frames, interlocking base ten blocks) to build and compare ten ones and ten**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable Arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 1

Domain: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 1.NBT.2b Understand the following as a **special case**: The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones. **(SC 1)** **Essential Skills and Knowledge** • **Ability to use base ten manipulatives (e.g., base ten blocks, Digi-Blocks, Unifix Cubes, ten frames, interlocking base ten blocks) to build and compare 11 to 19** • **Ability to match the concrete representations of 11 through 19 with the numerical representations** **Standard: 1.NBT.2c** Understand the following as a special case: The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones). **(SC 1)** **Essential Skills and Knowledge** • **Ability to use base ten manipulatives (e.g., base ten blocks, Digi-Blocks, Unifix Cubes, ten frames, interlocking base ten blocks) to build and model the counting by tens** **Standard: 1.NBT.3** Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the Nemeth Braille Code symbols >, =, and <. **Essential Skills and Knowledge** • **Ability to apply their understanding of the value of tens and ones in order to compare the magnitude of two numbers.** • **Ability to use base ten manipulatives to represent the numbers and model the comparison of their values**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable Arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 1

Domain: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	• **Ability to represent their reasoning about the comparison of two two-digit numbers using pictures, numbers, and words** • **Ability to use Cardinality to compare the quantity of the numbers with models** • **Ability to use Ordinality to compare the placement of the numbers on the number line or 100s chart** • **Knowledge of the symbols >, =, < and their meaning**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable Arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Use place value understanding and properties of operations to add and subtract.	**Standard: 1.NBT.4** Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or tactile graphics of drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones, and sometimes it is necessary to compose a ten. Read and write equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator. **Essential Skills and Knowledge** • **Knowledge of addition and subtraction fact families** • **Ability to model addition and subtraction using base ten manipulatives (e.g., base ten blocks, Digi-Blocks, Unifix cubes) and explain**	

GRADE 1

Domain: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	the process • **Knowledge of place value** • **Ability to use a variety of methods that could involve invented, flexible or standard algorithmic thinking (e.g., expanded form, partial sums, a traditional algorithm)** **Standard: 1.NBT.5** Given a two-digit number in Nemeth Braille Code, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. **Essential Skills and Knowledge** • **Ability to use base ten manipulatives, a tactile graphic of number lines or braille hundreds charts to model finding 10 more and explain reasoning** • **Knowledge of addition and subtraction fact families** • **Ability to model addition using base ten manipulatives (e.g., base ten blocks, Digi-Blocks, Unifix cubes) and explain the process** • **Knowledge of place value and skip counting forward by 10**	**1. Model with mathematics.** **2. Use appropriate tools strategically.** **3. Attend to precision.** **4. Look for and make use of structure.** **5. Look for and express regularity in repeated reasoning.** **6. Model with mathematics.** **7. Use appropriate tools strategically.** **8. Attend to precision.**

GRADE 1

Domain: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 1.NBT.6 Subtract multiples of 10 in the range of 10-90 from multiples of 10 in the range of 10-90 (positive or zero differences), using concrete models or tactile graphics of drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Read and write equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator. **Essential Skills and Knowledge** • **Ability to use base ten manipulatives, tactile graphics of number lines or braille hundreds charts to model finding 10 less and explain reasoning** • **Knowledge of addition and subtraction fact families** • **Ability to model subtraction using base ten manipulatives (e.g., base ten blocks, Digi-Blocks, Unifix cubes) and explain the process** • **Knowledge of place value and skip counting by 10**	**1. Model with mathematics.** **2. Use appropriate tools strategically.** **3. Attend to precision.** **4. Look for and make use of structure.** **5. Look for and express regularity in repeated reasoning.** **6. Model with mathematics.** **7. Use appropriate tools strategically.** **8. Attend to precision.**

GRADE 1

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Reason with shapes and their attributes.	**Standard: 1.G.1** Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., labeled color, orientation, overall size); build and draw tactile graphics of shapes to possess defining attributes. **Essential Skills and Knowledge** • **Ability to sort shapes (e.g., attribute blocks, polygon figures) by shape, number of sides, size or number of angles** • **Ability to use geoboards, toothpicks, straws, paper and pencil, tactile drawing tools, and accessible computer games to build shapes that possess the defining attributes** • **Ability to explain how two shapes are alike or how they are different from each other**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable Arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 1

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 1.G.2 Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape. **Essential Skills and Knowledge** • **Ability to use concrete manipulatives (e.g., pattern blocks, attribute blocks, cubes, rectangular prisms, cones, cylinders, geoboards, paper & pencil, tactile drawing tools) to create composite shapes from 2 or 3 dimensional shapes** **Standard: 1.G.3** Partition manipulatives and tactile graphics of circles and rectangles into two and four equal shares, describe the shares using the words halves, fourths, and quarters, and use the phrases half of, fourth of, and quarter of. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares. **(SC 1)** **Essential Skills and Knowledge** • **Knowledge that the whole or unit has been partitioned into equal–sized portions or fair shares** • **Ability to apply the concept of sharing equally with friends lays the foundation for fractional understanding.** • **Ability to model halves and fourths with concrete materials**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Represent and solve problems involving addition and subtraction.	**Standard: 2.OA.1** Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using tactile graphics of drawings, and equations with a symbol for the unknown number to represent the problem. To represent unknown symbols in Nemeth Braille Code, use: • symbol of omission for question mark • double dash for blank line • square shape indicator for box/square Read and write equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator. **Essential Skills and Knowledge** • **Ability to explore addition and subtraction with manipulatives to build their conceptual understanding (e.g., snap cubes, subitizing cards, tens frames, hundreds charts, number lines and empty number lines)** • **Ability to take apart and combine numbers in a wide variety of ways** • **Ability to make sense of quantity and be able to compare numbers** • **Ability to record their thinking using Nemeth Braille Code symbols for >, =, and < when comparing quantities** • **Ability to use flexible thinking strategies to develop the understanding of the traditional algorithms and their processes** • **Knowledge of and ability to apply properties of addition and subtraction**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	(CCSS, Page 90, Table 3) • **Ability to apply the knowledge of addition and subtraction to choose the most efficient strategy to solve a problem** • **Ability to solve various types of addition and subtraction word problems (CCSS, Page 88, Table 1)** • **Ability to use □ using the square shape indicator or ? using the sign of omission to represent an unknown in an equation**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable Arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Add and subtract within 20.	**Standard: 2.OA.2** **Fluently** add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers. **(SC 2)** **Essential Skills and Knowledge** • **Ability to apply counting strategies to develop automatic recall** • **Ability to use reasoning strategies to make use of known facts (e.g., sums of ten, making ten, doubles, near doubles/inside doubles, doubles plus, counting on)** • **Knowledge that subtraction is the inverse of addition (e.g., fact families)**	
Work with equal groups of objects to gain foundations for multiplication.	**Standard: 2.OA.3** Determine whether a group of objects (up to 20 has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation in Nemeth Braille Code to express an even number as a sum of two equal addends. **(SC 2)**	

GRADE 2

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	Essential Skills and Knowledge • **Ability to use concrete materials to model the meaning of odd and even numbers.** • **Knowledge that writing an equation to express an even number as the sum of two equal addends is the same as using doubles (e.g., 4 + 4 = 8, 7 + 7 = 14).** • **Ability to skip count by twos.** **Standard: 2.OA.4** Use addition to find the total number of real and/or tactile graphics of objects arranged in **rectangular arrays** with up to 5 rows and up to 5 columns; write an equation in Nemeth Braille Code to express the total as a sum of equal addends. **Essential Skills and Knowledge** • **Ability to construct rectangular arrays using concrete manipulatives** • **Ability to use repeated addition to find the number of objects in a an array** • **Knowledge of rectangular arrays as a foundation for multiplication and a model of the connection between addition and multiplication**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable Arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
Understand place value.	**Standard: 2.NBT.1** Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. **(SC 2)** **Essential Skills and Knowledge** • **Ability to use adapted base ten manipulatives (e.g., base ten blocks, Digi-Blocks, stacks of cubes, bundles of sticks, place value arrow cards)** • **Knowledge of the value of each place in a number** • **Knowledge of the value of a digit in a specific place** • **Knowledge that the placement of a digit affects the value of that digit** • **See 2NBT1a&b for additional skills and knowledge that are needed for this Standard** **Standard: 2.NBT.1a** Understand the following as a special case: 100 can be thought of as a bundle of ten tens -- called a "hundred." **Essential Skills and Knowledge** • **Ability to compose and decompose 100 in a variety of ways lays foundation for regrouping** • **Apply the ability to count by tens**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 2.NBT.1b Understand the following as a special case: The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones). **Essential Skills and Knowledge** • **Ability to count by hundreds using place value manipulatives** • **Ability to count by hundreds verbally** **Standard: 2.NBT.2** Count within 1000; skip-count by 5s, 10s, and 100s. **Essential Skills and Knowledge** • **Ability to skip count within 100 using the hundreds chart and 1000 using the thousands chart** • **Ability to skip-count starting from various numbers (e.g., counting by tens starting with 27)** • **Ability to determine patterns when skip-counting** **Standard: 2.NBT.3** Read and write numbers to 1000 in Nemeth Braille Code using base-ten numerals, number names, and expanded form. **(SC 2)** **Essential Skills and Knowledge** • **Knowledge of the value of digits within a multi-digit number** • **Knowledge of and ability to represent numbers using concrete materials (e.g., base ten blocks, Digi-blocks, place value arrow cards) as well as written numerals and number words** • **Ability to justify the representation with word form and written numerals**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable Arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 2.NBT.4 Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using Nemeth Braille Code symbols for >, =, and < symbols to record the results of comparisons. **(SC 2)** **Essential Skills and Knowledge** • **Ability to apply place value knowledge to make comparisons (e.g., Look at greatest place value first and compare those digits to see which is greater)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable Arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Use place value understanding and properties of operations to add and subtract.	**Standard: 2.NBT.5** Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. **(SC 2)** **Essential Skills and Knowledge** • **Knowledge of addition and subtraction fact families** • **Ability to model regrouping using base ten manipulatives (e.g., base ten blocks, Digi-Blocks, adapted place value arrow cards)** • **Knowledge that when regrouping, the value of the number does not change but the place values of the digits within that number change (e.g., When regrouping the problem 324 – 116, 324 becomes 300 + 10 + 14 in order to regroup)** Read and write equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator.	

GRADE 2

DOMAIN: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 2.NBT.6 Add up to four two-digit numbers using strategies based on place value, properties of operations. **Essential Skills and Knowledge** • **Knowledge of and ability to apply strategies such as expanded form, empty number line and partial sums** **Standard: 2.NBT.7** Add and subtract within 1000, using concrete models or tactile graphics of drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** Read and write equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator. **Standard: 2.NBT.8** Mentally add 10 or 100 to a given number 100-900, and mentally subtract 10 or 100 from a given number 100-900. **Essential Skills and Knowledge** • **Ability to skip count from a number by 10 and/or 100 including off the decades** • **Ability to model using base ten manipulatives**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	• **Ability to recognize and use patterns in a Nemeth Braille Code thousands chart** **Standard: 2.NBT.9** Explain why addition and subtraction strategies work, using place value and the properties of operations. **Essential Skills and Knowledge** • **Ability to use the properties (commutative property for addition, associative property for addition, zero property, identity property) to compute and to support their explanation (CCSS, Page 90, Table 3)** • **Ability to reason mathematically and explain why their chosen strategy works using words, tactile graphics of pictures, and/or Nemeth Braille Code symbols to support their explanation**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
Measure and estimate lengths in standard units.	**Standard: 2.MD.1** Measure the length of an object by selecting and using appropriate braille tools such as rulers, yardsticks, meter sticks, and measuring tapes. **Essential Skills and Knowledge** • **Ability to measure to the nearest inch, centimeter, yard, or meter** • **Knowledge of and ability to explain why we use standard units of measurement instead of non-standard units** • **Ability to estimate before measuring to help determine the appropriate measurement tool and unit** • **Knowledge of the connection between a ruler and a number line** • **Ability to measure real-world objects** **Standard: 2.MD.2** Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen. **Essential Skills and Knowledge** • **Ability to recognize the equivalent units of 12 inches = 1 foot and 100 centimeters = 1 meter as well as non-standard equivalent measurements** **Standard: 2.MD.3** **Estimate** lengths using units of inches, feet, centimeters, and meters. **Essential Skills and Knowledge** • **Ability to use a benchmark when estimating** • **Ability to compare estimates to actual measurements**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable Arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 2.MD.4 Measure to determine how much longer one object is than another, expressing the length **difference** in terms of a standard length unit. **Essential Skills and Knowledge** • **Ability to connect measurement comparisons to subtraction (comparing) and addition (counting on)**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable Arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**
Relate addition and subtraction to length.	**Standard: 2.MD.5** Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using tactile graphics of drawings (such as drawings of rulers) and **equations** using Nemeth Braille Code with a symbol for the unknown number to represent the problem. To represent unknown symbols in Nemeth Braille Code, use: • symbol of omission for question mark • double dash for blank line • square shape indicator for box/square Read and write equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator. **Essential Skills and Knowledge** • **Ability to develop equations to represent word problems** • **Knowledge of inverse relationships** • **Ability to justify the reasonableness of their responses**	

GRADE 2

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 2.MD.6 Represent whole numbers as lengths from 0 on a tactile graphic of a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, …, and represent whole-number sums and differences within 100 on a tactile graphic of a number line diagram. **Essential Skills and Knowledge** • **Ability to locate and represent points on a number line** • **Ability to apply knowledge of anchor points (e.g., 5, 10, 25, 50, 75) as being half-way points between numerals**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.**
Work with time and money.	**Standard: 2.MD.7** Tell and write time in Nemeth Braille Code on manipulatives and tactile graphics of analog and digital clocks to the nearest five minutes, using a.m. and p.m. **(SC 2)** **Essential Skills and Knowledge** • **Knowledge of and ability to apply skip counting by 5** • **Knowledge that there are 60 minutes in a hour, 60 seconds in a minute, 24 hours in a day, 12 hours in a.m. and 12 hours in p.m., and know when a.m. and p.m. occur** • **Knowledge of the difference between the minute and hour hands and their purposes** • **Knowledge of concept of quarter-hours and half-hours** • **Knowledge that there are five-minute intervals between each number on the clock face**	4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 2.MD.8 Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using Nemeth Braille Code $ and ¢ symbols appropriately. • Identify real coins by their size and texture • Identify and count Nemeth Braille Code abbreviations for money: $1, qr for quarter, dm for dime, nk for nickel, pn for penny **Essential Skills and Knowledge** • **Ability to identify both sides of currency** • **Ability to count money (dollar bills, quarters, dimes, nickels, and pennies)** • **Ability to count mixed sets of currency** • **Ability to count on** • **Knowledge of and ability to apply possible strategies such as drawing tactile graphics of pictures, using coins, using a braille number grid, using a tactile graphic of a number line, using Nemeth Braille Code symbols and/or numbers**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable Arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 2.MD.9 Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a **line plot** using tactile graphics for the number line and a full braille cell for data plots where the horizontal scale is marked off in whole-number units. **Essential Skills and Knowledge** • **Understand that a line plot is a representation of data along a number line** • **Ability to identify patterns within the set of data and analyze what the data represents**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**
Represent and interpret data.	**Standard: 2.MD.10** Draw a **picture graph** using a full braille cell to represent each picture and a **bar graph** using tactile drawing tools/braille writer(with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. **(SC 2)** **Essential Skills and Knowledge** • **Ability to collect, sort, organize and graph data** • **Knowledge of the elements of picture graphs and bar graphs** • **Ability to analyze graphs, answer questions about the data, and make decisions based on the data**	

GRADE 2

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Reason with shapes and their attributes.	**Standard: 2.G.1** Recognize and draw shapes using tactile graphics and tactile drawing tools having specific attributes, such as a given number of **angles** or a given number of equal **faces**. Identify tactile graphics of **triangles**, **quadrilaterals**, **pentagons**, **hexagons**, and **cubes**. **Essential Skills and Knowledge** • **Ability to sort shapes by common attributes** • **Knowledge that plane figures are named by the number of sides** • **Knowledge and investigations include both regular and irregular polygons. (e.g., both equilateral and scalene triangles)** **Standard: 2.G.2** Partition a manipulative/tactile graphic rectangle into rows and columns of same-size squares and count to find the total number of them. **(SC 2)** **Essential Skills and Knowledge** • **Ability to partition rectangles into rows and columns of same-size squares lays the foundation for the development of multiplication, area, and fractions** • **Ability to use concrete materials (e.g., labeled color tiles and cubes) to partition a rectangle** • **Ability to apply repeated addition when counting total number of partitions**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable Arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 2

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
	Standard: 2.G.3 Partition a manipulative/tactile graphic of circles and rectangles into two, three, or four equal shares, describe the shares using the words ***halves***, ***thirds***, *half of, a third of, etc.,* and describe the whole as two halves, three thirds, four **fourths**. Recognize that equal shares of identical wholes need not have the same shape. **(SC 2)** **Essential Skills and Knowledge** • **Ability to partition circles and rectangles into equal parts lays the foundation for the development of fractions** • **Ability to model using concrete materials (e.g., paper folding, geoboards, fraction manipulatives) to create equal shares**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable Arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Represent and solve problems involving multiplication and division.	**3.OA.1** Interpret **products** of whole numbers, e.g., interpret 5 x 7 Nemeth Braille Code using the multiplication cross as the total number of objects/tactile graphics in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5 x 7.* **(SC, 3)** **Essential Skills and Knowledge** • **Knowledge that multiplication is the process of repeated addition, arrays, and/or equal groups** • **Ability to use concrete objects, tatile graphics of pictures, and arrays to represent the product as the total number of objects** • **Knowledge that the product represented by the array is equivalent to the total of equal addends (2OA4)** • **Ability to apply knowledge of repeated addition up to 5 rows and 5 columns and partitioning, which leads to multiplication (2OA4)** • **Knowledge that the example in Standard 30A1 can also represent the total number of objects with 5 items in each of 7 groups (Commutative Property)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	3.OA.2 Interpret whole-number **quotients** of whole numbers, e.g., interpret 56 ÷ 8 in Nemeth Braille Code using the sign for division and the division cage as the number of objects/tactile graphics in each **share** when 56 objects are **partitioned** equally into 8 shares, or as a number of shares when 56 objects are **partitioned** into equal shares of 8 objects each. *For example, describe a context in which a number of shares or a number of groups can be expressed as 56 ÷8.* **(SC, 3)** **Essential Skills and Knowledge** • **Knowledge that division is the inverse of multiplication and the process of repeated subtraction** • **Ability to use concrete objects to represent the total number and represent how these objects could be shared equally** • **Knowledge that the quotient can either represent the amount in each group or the number of groups with which a total is shared** • **Knowledge that just as multiplication is related to repeated addition, division is related to repeated subtraction**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, **arrays**, and **measurement quantities**, e.g., by using drawings/tactile graphics and equations with a symbol for the unknown number to represent the problem. To represent unknown symbols in Nemeth Braille Code, use: • symbol of omission for question mark • double dash for blank line • square shape indicator for box/square **Essential Skills and Knowledge** • **Ability to determine when to use multiplication or division to solve a given word problem situation** • **Ability to solve different types of multiplication and division word problems (CCSS, Page 89, Table 2)** **3.OA.4** Determine the unknown whole number in a multiplication or division equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations* *8 x ? = 48, 5 = □ ÷ 3, 6 x 6 = ?* To represent unknown symbols in Nemeth Braille Code, use: • symbol of omission for question mark • double dash for blank line • square shape indicator for box/square **Essential Skills and Knowledge** • **Ability to use concrete objects to compose and decompose sets of numbers**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	• **Ability to use the inverse operation as it applies to given equation** • **Knowledge of fact families** • **Ability to find the unknown in a given multiplication or division equation, where the unknown is represented by a question mark, a box, or a blank line** • **Ability to solve problems that employ different placements for the unknown and product/quotient** **(Examples: 5 x __ = 15 15 = 3 x __** **15 ÷ 3 = __ 15 ÷ __ = 5 15 = 5 x __** **__ = 15 ÷ 3 3 = __ ÷ 5)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Understand properties of multiplication and the relationship between multiplication and division.	**3.OA.5** Apply **properties of operations** as strategies to multiply and divide <u>using Nemeth Braille Code for parentheses.</u> • *If 6 x 4 = 24 is known, then 4 x 6 = 24 is also known. (Commutative property of multiplication)* • *3 x 5 x 2 can be found by 3 x 5 = 15, then 15 x 2 = 30, or by 5 x 2 = 10, then 3 x 10 = 30. (Associative property of multiplication)* • *Knowing that 8 x 5 = 40 and 8 x 2 = 16, one can find 8 x 7 as 8 x (5 + 2) = (8 x 5) + (8 x 2) which leads to 40 + 16 = 56. (Distributive property)* **(SC 3)** **Essential Skills and Knowledge** • **Ability to break apart and manipulate the numbers (decomposing and composing numbers)** • **Knowledge of the properties of multiplication include Zero, Identity, Commutative, Associative and Distributive properties (CCSS, Page 90,**	

GRADE 3

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	Table 3) • **Knowledge that the properties of division include the Distributive Property, but not Commutative or Associative.** • **Ability to understand and apply the Properties of Operations as opposed to simply naming them** • **Ability to apply the Properties of Operations as strategies for increased efficiency** **3.OA.6** Understand division as an unknown-factor problem using Nemeth Braille Code. *For example, find 32 ÷ 8 by finding the number that makes 32 when multiplied by 8.* **(SC 3)** **Essential Skills and Knowledge** • **Knowledge that multiplication is the inverse operation of division** • **Ability to apply knowledge of multiplication to solve division problems**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Multiply and divide within 100.	**3.OA.7** **Fluently** multiply and divide within 100 using Nemeth Braille Code, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 x 5 = 40, one knows 40 ÷ 5 = 8) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers. **Essential Skills and Knowledge** • **Knowledge of multiplication and division strategies and properties to achieve efficient recall of facts** • **Ability to use multiple strategies to enhance understanding** • **Ability to model the various properties using concrete materials**	

GRADE 3

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Solve problems involving the four operations, and identify and explain patterns in arithmetic.	**3.OA.8** Solve two-step word problems using the four operations. Represent these problems in Nemeth Braille Code using equations with a letter standing for the unknown quantity and use of the English Letter Indicator as appropriate. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. **Essential Skills and Knowledge** • **Knowledge of strategies for word problems as established for addition and subtraction (2.OA.1)** • **Ability to solve word problems that use whole numbers and yield whole-number solutions** • **Ability to determine what a reasonable solution would be prior to solving the word problem** • **Knowledge that a variable refers to an unknown quantity in an equation that can be represented with any letter other than "o"** • **Knowledge that the letter representing a variable takes the place of an empty box or question mark as used to indicate the unknown in earlier grades** • **Ability to use various strategies applied in one-step word problems to solve multi-step word problems** • **Knowledge of and the ability to use the vocabulary of equation vs. expression** • **Knowledge of and ability to apply estimation strategies, including rounding and front-end estimation, to make sense of the solution(s)** • **Ability to apply knowledge of place value to estimation**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	• **Ability to use critical thinking skills to determine whether an estimate or exact answer is needed in the solution of a word problem** **3.OA.9** Identify arithmetic patterns in Nemeth Braille Code (including patterns in the addition table or multiplication table), and explain them using properties of operations. *For example, observe that 4 times a number is always even and explain why 4 times a number can be decomposed into two equal addends.* **(SC 3)** **Essential Skills and Knowledge** • **Ability to apply knowledge of skip counting (1.OA 5 and 2.NBT.2) and explain "why" the pattern works the way it does as it relates to the properties of operations** • **Ability to investigate, discover, and extend number patterns and explain why they work.** • **Knowledge that subtraction and division are not commutative as addition and multiplication are** • **Knowledge of multiplication and division properties (CCSS, Page 90, Tables 3&4)** • **Ability to apply knowledge of Properties of operations to explain patterns and why they remain consistent**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
Use place value understanding and properties of operation to perform multi-digit arithmetic.	**3.NBT.1** Use place value understanding to round whole numbers to the nearest 10 or 100 using Nemeth Braille Code. **Essential Skills and Knowledge** • **Knowledge of place value through 1,000 (2.NBT.1) to provide the foundation for rounding whole numbers** • **Knowledge that place value refers to what a digit is worth in a number** • **Knowledge that each place in a number is worth 10 times more than the place to the right of it (The tens column is worth 10 ones, the hundreds column is worth 10 tens.)** • **Ability to use a variety of strategies when rounding (e.g., tactile graphic of a number line, proximity, and braille hundreds chart)** • **Ability to round a three-digit number to the nearest 10 or 100** **NBT.2** **Fluently** add and subtract using Nemeth Braille Code within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction using Nemeth Braille Code . Read equations in spatial arrangements involving regrouping using the carried number indicator and cancellation indicator. **(SC 3)** **Essential Skills and Knowledge** • **Knowledge of and ability to apply strategies of decomposing and composing numbers, partial sums,**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	counting up, and counting back by ones, tens, and hundreds • **Ability to apply alternative algorithms as appropriate** • **Ability to use addition and subtraction interchangeably in computation based on the relationship between the operations** **3.NBT.3** Multiply one-digit whole numbers by multiples of 10 in the range of 10-90 (e.g., 9 x 80, 5 x 60) using Nemeth Braille Code and strategies based on place value and properties of operations. **(SC 3)** **Essential Skills and Knowledge** • **Ability to apply knowledge of place value (e.g., 9 x 80 is 9 times 8 tens = 72 tens)** • **Ability to apply the Properties of Operations (CCSS, Page 90, Tables 3 & 4)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
Develop understanding of fractions as numbers.	**3.NF.1** Understand a fraction *1/b* as the quantity formed by 1 part when a whole is partitioned into *b* equal parts; understand a fraction *a/b* as the quantity formed by *a* parts of size *1/b* <u>Read and write simple fractions with the formats for using either a horizontal or diagonal fraction bar in Nemeth Braille Code.</u> <u>Read simple fractions using spatial arrangement in Nemeth Braille Code.</u> **Essential Skills and Knowledge** • **Knowledge of the relationship between the number of equal shares and the size of the share (1.G.3)** • **Knowledge of equal shares of circles and rectangles divided into or partitioned into halves, thirds, and fourths (2.G.3)** • **Knowledge that, for example, the fraction ¼ is formed by 1 part of a whole which is divided into 4 equal parts** • **Knowledge that, for example, the fraction ¾ is the same as ¼ + ¼ + ¼ (3 parts of the whole when divided into fourths)** • **Knowledge of the terms numerator (the number of parts being counted) and denominator (the total number of equal parts in the whole)** • **Knowledge of and ability to explain and write fractions that represent one whole (e.g., 4/4, 3/3)** • **Ability to identify and create fractions of a region and of a set, including the use of concrete materials** • **Knowledge of the size or quantity of the original whole when working with fractional parts**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	3.NF.2 Understand a fraction in Nemeth Braille Code as a number on the number line; represent fractions on a tactile graphic of a number line diagram. (SC 3) **Essential Skills and Knowledge** • **Ability to apply knowledge of whole numbers on a tactile graphic of a number line to the understanding of fractions on a tactile graphic of a number line** • **Ability to apply knowledge of unit fractions to represent and compute fractions on a tactile graphic of a number line** • **Knowledge of the relationship between fractions and division. (Division separates a quantity into equal parts. Fractions divide a region or a set into equal parts)** • **Ability to use linear models (e.g., equivalency table in Nemeth Braille code and adapted manipulatives such as fraction strips, fraction towers, Cuisenaire rods) for fraction placement on a number line** • **Knowledge of the relationship between the use of a braille ruler in measurement to the use of a ruler as a number line** • **Knowledge that a tactile graphic of a number line does NOT have to start at zero** • **Ability to identify fractions on a tactile graphic number line with tick marks as well as on number lines without tick marks**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	3.NF.2a Represent a fraction *1/b* in Nemeth Braille Code on a tactile graphic number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into *b* equal parts. Recognize that each part has size *1/b* and that the endpoint of the part based at 0 locates the number *1/b* on the number line. (SC 3) **Essential Skills and Knowledge** • **Knowledge of the meaning of the parts of a fraction (numerator and denominator)** • **Knowledge of fraction 1/b as the unit fraction of the whole.** • **Knowledge that when the denominator is 4, each space between the tick marks on a number line is ¼.** **3.NF.2b** Represent a fraction *a/b* in Nemeth Braille Code on a tactile graphic of a number line diagram by marking off *a* lengths of *1/b* from 0. Recognize that the resulting interval has size *a/b* and that its endpoint locates the number *a/b* on the number line. (SC 3) **Essential Skills and Knowledge** • **Knowledge that when counting parts of a whole, the numerator consecutively changes but the denominator stays the same. (Example: 1/4, 2/4, 3/4, 4/4 or 1)** • **Ability to explain, for example, that when *a* is 2 and *b* is 4, the fraction 2/4 on a number line would be the second tick mark from zero or when *a* is 3 and *b* is 4, the fraction ¾ on a number line would be the third tick mark from zero.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	3.NF.3 Explain equivalence of fractions in Nemeth Braille Code in special cases, and compare fractions by reasoning about their size. **Essential Skills and Knowledge** • **Ability to use concrete manipulatives and tactile graphics of visual models to explain reasoning about fractions** • **Knowledge that equivalent fractions are ways of describing the same amount by using different-sized fractional parts. (e.g., 1/2 is the same as 2/4 or 3/6 or 4/8)** • **Ability to use a variety of models when investigating equivalent fractions (e.g., tactile graphic of a number line, Cuisenaire rods, fraction towers, fraction circles, equivalence table, fraction strips)** • **Ability to relate equivalency to fractions of a region or fractions of a set** • **Ability to use benchmarks of 0, ½ and 1 comparing fractions** • **Knowledge of and experience with fractional number sense to lay foundation for manipulating, comparing, finding equivalent fractions, etc.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	3.NF.3a Represent two fractions in Nemeth Braille Code as equivalent (equal) if they are the same size, or the same point on the number line in a tactile graphic. **Essential Skills and Knowledge** • **Ability to describe the same amount by using different-sized fractional parts. (e.g., ½ is the same as 2/4 or 3/6 or 4/8)** • **Ability to use tactile graphics of number lines as well as fractions of a set or fractions of a region to model equivalent fractions** • **Ability to use a variety of models to investigate relationships of equivalency** **3.NF.3b** Recognize and generate simple equivalent fractions, e.g., ½ = 2/4, 4/6 = 2/3) using Nemeth Braille Code. Explain why the fractions are equivalent, e.g., by using a tactile graphic of a visual fraction model. **Essential Skills and Knowledge** • **Ability to describe the same amount by using different-sized fractional parts. (e.g., ½ is the same as 2/4 or 3/6 or 4/8)** • **Ability to use fraction models (e.g., fraction towers, fraction strips) to justify understanding of equivalent fractions**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	3.NF.3c Express whole numbers as fractions using Nemeth Braille Code, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form 3 = 3/1; recognize that 6/1 = 6; locate 4/4 and 1 at the same point of a number line diagram.* **Essential Skills and Knowledge** • **Knowledge of the denominator as the number of parts that a whole is divided into in order to explain why a denominator of 1 indicates whole** **3.NF.3d** Using Nemeth Braille Code, compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the Nemeth Braille Code symbols >, =, or <, and justify the conclusions, e.g., by using a tactile graphic of a visual fraction model. **Essential Skills and Knowledge** • **Ability to use benchmarks of 0, ½ and 1 to explain relative value of fractions** • **Knowledge that as the denominator increases the size of the part decreases** • **Knowledge that when comparing fractions the whole must be the same** • **Ability to use a variety of models when comparing fractions (e.g., tactile graphic of a number line, braille equivalence table, and manipulatives such as Cuisenaire rods, fraction towers, fraction circles, fraction strips)**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

Domain: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects	**3.MD.1** Tell and write time in Nemeth Braille Code to the nearest minute on a tactile graphic of a clock and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram. **Essential Skills and Knowledge** • **Ability to tell time to the nearest 5-minute interval (2.MD.7)** • **Ability to tell time to the nearest minute in a.m. and p.m.** • **Ability to measure time intervals in minutes** • **Ability to solve time problems by using the number line model as opposed to an algorithm** • **Ability to initially add minutes in order to find the end time followed by working backwards to find start time** • **Ability to find the elapsed time of an event** • **Ability to relate fractions and time (1/4 with quarter hour, ½ with half past the hour)** • **Ability to find start time, end time, or elapsed time**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects	**3.MD.2** Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using tactile graphics of drawings (such as a beaker with a measurement scale) to represent the problem. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Represent and interpret data.	**3.MD.3** Draw a **scaled picture graph** and a **scaled bar graph** using Nemeth Braille Code and tactile drawing tools to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.* **(SC, 3)** **Essential Skills and Knowledge** • **Knowledge that the use of "square" is referring to interval on the scale and that not all graphs will include a "square" but all graphs should include intervals** • **Ability to apply experience with constructing and analyzing simple, single-unit scaled bar and picture graphs (pictograph) with no more than 4 categories (2.MD.10).**	

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
Represent and interpret data.	• **Knowledge of increased scale and intervals (moving to graphs representing more than one item and the intervals representing 2, 5, 10 on the graph, etc.) and expanding to one-step and two-step problem-solving with given data** • **Knowledge that the interval of scale is the amount from one tick mark to the next along the axis and that the scale would be determined based on the values being represented in the data** • **Knowledge of and ability to connect understanding of locating points on a number line with locating points between intervals on a given axis. (e.g., if given a scale counting by 5s students would need to be able to estimate the location of 13 between intervals of 10 and 15.)** • **Ability to apply the information in the Key when interpreting fractions of a symbol on a picture graph <u>by using the symbol to representative a half picture (dots 4, 5, 6)</u>** **3.MD.4** Generate measurement data by measuring lengths using <u>braille</u> rulers marked with halves and fourths of an inch. Show the data by making a <u>tactile graphic of a</u> **line plot** where the horizontal scale is marked off in appropriate units – whole numbers, halves, or quarters. **Essential Skills and Knowledge** • **Ability to apply prior experience with the measurement of lengths being marked and recorded on line plots to the nearest whole unit (3.NF.2)**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
Geometric measurement: understand and relate multiplication and addition concepts of area	**3.MD.5** Recognize **area** as an attribute of tactile graphics of plane figures and understand concept of area measurement. **(SC 3)** **Essential Skills and Knowledge** • **Ability to apply experience with partitioning rectangles into rows and columns to count the squares within (2.OA.4)** • **Knowledge that area is the measure of total square units inside a region or how many square units it takes to cover a region** **3.MD.5a** A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area in a tactile graphic. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **3.MD.5b** A tactile graphic of a plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units. **(SC 3)** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

Domain: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
Geometric measurement: understand and relate multiplication and to addition concepts of area	**3.MD.6** Measure areas in a tactile graphic by counting unit squares (square cm, square m, square in., square ft., and improvised units). **(SC 3)** **Essential Skills and Knowledge** • **Ability to use manipulatives and ~~visual~~ tactual models to calculate area** **3.MD.7** Relate area to the operations of multiplication and addition using Nemeth Braille Code and tactile graphics. **(SC 3)** **Essential Skills and Knowledge** • **Ability to explain the relationship of multiplication arrays and area (3.OA.3)** **3MD.7a** Find the area of a tactile graphic of a rectangle with whole-number side lengths by **tiling** it, and show that the area is the same as would be found by multiplying the side lengths. **Essential Skills and Knowledge** • **Ability to justify the understanding of area by comparing tiling and counting with repeated addition/multiplication**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 3

Domain: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	3.MD.7b Multiply side lengths to find areas of tactile graphics of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning. **Essential Skills and Knowledge** • **Ability to apply the formula for area of a rectangle to solve word problems** **3.MD.7c** Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths *a* and *b + c* is the sum of *a x b* and *a x c*. Use tactile area models to represent the distributive property in mathematical reasoning. **Essential Skills and Knowledge** • **Ability to construct rectangles on grid paper and decompose them by cutting them up or labeling ~~color coding~~ them to investigate area** • **Ability to use a pictorial model of the distributive property to solve area word problems** • **Knowledge that, for example, when working with a rectangle with side lengths of 7units by 8units, let *a* represent 7 and *b+c* represent a decomposition of 8 (e.g. 5+3, 6+2, 4+4, 7+1, etc.) In other words, 7x8 is the same as (7x2)+(7x6)**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 3

Domain: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	3.MD.7d Recognize area as additive. Find areas of tactile graphics of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems. Recognize the tactile representation of a right angle. **Essential Skills and Knowledge** • **This is an extension of 3.MD.7c. Knowledge that rectilinear figures refer to any polygon with all right angles**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.**
Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.	**3.MD.8** Solve real world and mathematical problems involving **perimeters** of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters. Students will use tactile graphics of polygons when provided in print. **Essential Skills and Knowledge** • **Knowledge that the perimeter is the distance around a region** • **Ability to use manipulatives and tactile graphics/visual models to find the perimeter of a polygon** • **Ability to apply a variety of strategies to find the perimeter of a polygon** • **Ability to explain and model the relationship between area and perimeter using concrete materials (e.g., color tiles and geoboards).**	**5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in rep**

GRADE 3

Domain: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Reason with shapes and their attributes	**3.G.1** Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize tactile graphics of rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories using tactile tools. **(SC 3)** **Essential Skills and Knowledge** • **Ability to compare and sort polygons based on their attributes, extending beyond the number of sides (2.G.1)** • **Ability to explain why two polygons are alike or why they are different based on their attributes** **3.G.2** Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole using Nemeth Braille code. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as ¼ f the area of the shape.* **(SC 3)** **Essential Skills and Knowledge** • **Knowledge that this is a geometry application of unit fractions (3.NF.1) and ability to make use of unit fraction understanding.** • **Ability to use concrete materials to divide shapes into equal areas (e.g., pattern blocks , color tiles, geoboards)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Use the four operations with whole numbers to solve problems.	**4.OA.1** Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 x 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of **multiplicative comparisons** as multiplication **equations** using Nemeth Braille Code. **Essential Skills and Knowledge** • **Knowledge of and ability to apply understanding of multiplication as repeated addition (2OA4), as "equal groups of" (3OA1), and the Commutative Property (3OA5)** **4.OA.2** Multiply or divide to solve word problems involving **multiplicative comparison**, e.g., by using tactile graphics of drawings and **equations** using Nemeth Braille Code with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from **additive comparison**. **Essential Skills and Knowledge** • **Ability to solve various types of problems involving multiplication and division (CCSS, Page 89, Table 2) through initial use of concrete materials and pictures, leading to the use of equations as a tool in solutions** **4.OA.3** Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted using Nemeth Braille Code. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	answers using mental computation and estimation strategies including rounding. **Essential Skills and Knowledge** • **Ability to apply knowledge of addition, subtraction, multiplication, and/or division appropriately to solve multi-step word problems through the use of equations** • **Ability to put the remainder in a division word problem in context and interpret it appropriately to determine if it should be discarded, replaced with the next highest whole number answer, or used as the answer to the question** **Write the Nemeth Braille Code symbol for remainder in the correct format in a division problem**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**
Gain familiarity with factors and multiples.	**4.OA.4** Find all **factor pairs** for a whole number in the range 1-100 using Nemeth Braille Code. Recognize that a whole number is a **multiple** of each of its factors. Determine whether a given whole number in the range 1-100 is a multiple of a given one-digit number. Determine whether a given whole number in the range of 1-100 is **prime** or **composite**. **(SC 4)** **Essential Skills and Knowledge** • **Knowledge of multiplication as arrays and its connection to area of rectangles to determine factor pairs** • **Knowledge of and ability to apply multiplication facts to determine multiples of one-digit numbers** • **Ability to apply knowledge of basic multiplication facts to determine if products are prime or composite by determining all possible factor combinations for specific products**	

GRADE 4

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Generate and analyze patterns.	**4.OA.5** Generate a number or shape pattern that follows a given rule. Identify **apparent features** of the **pattern** that were not explicit in the rule itself. *For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.* **(SC 4)** **Essential Skills and Knowledge** • **Ability to apply knowledge of Growing Patterns versus Repeating Patterns using either numbers or shapes**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Number and Operation in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
Generalize place value understanding for multi-digit whole numbers.	**4.NBT.1** Recognize that in a Nemeth Braille Code multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of **place value** and division.* **(SC 4)** **Essential Skills and Knowledge** • **Knowledge of place value from prior grades (2.NBT.1-4, 3.NBT.3)** • **Knowledge of place value with whole numbers less than or equal to one million** **4.NBT.2** Read and write multi-digit whole numbers using Nemeth Braille Code using **base-ten numerals**, **number names,** and **expanded form**. Compare two multi-digit numbers based on meanings of the digits in each place, using Nemeth Braille Code for >, =, and < symbols to record the results of comparisons. **(SC 4)** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **4.NBT.3** Use **place value** understanding to round **multi-digit whole numbers** to any place. **Essential Skills and Knowledge** **See the skills and knowledge that are stated in the Standard.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Number and Operation in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
Use place value understanding and properties of operations to perform multi-digit arithmetic.	**4.NBT.4** Fluently add and subtract multi-digit whole numbers using the standard algorithm in Nemeth Braille Code. **Essential Skills and Knowledge** • **Knowledge of various types of algorithms (CCSS, Page 88, Table 1)** • **Ability to apply a standard algorithm in both addition and subtraction problems** **4.NBT.5** Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using Nemeth Braille Code and strategies based on place value and the **properties of operations**. Illustrate and explain the calculation by using **equations**, tactile graphics of **rectangular arrays**, and/or **area models**. **Essential Skills and Knowledge** • **Knowledge of the use of arrays area models for multiplication (3.MD.6 & 3.MD.7)** • **Knowledge of and ability to apply the Properties of Operations (CCSS, Page 90, Table 3)** **4.NBT.6** Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division using Nemeth Braille Code and formatting for remainder. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. **Essential Skills and Knowledge** • **Ability to apply knowledge of multiplication and division within 100 (3.OA.7)** • **Ability to use arrays and area models for multiplication and division (3.MD.6 & 3.MD.7).** • **Knowledge of and ability to apply the Properties of Operations (CCSS, Page 90, Table**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
Extend understanding of fraction equivalence and ordering.	**4.NF.1** Explain why a fraction *a/b* is equivalent to a fraction *(n x a)/(n x b)* by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate **equivalent fractions**. **Essential Skills and Knowledge** • **Ability to use concrete materials to model fraction number concepts and values** • **Knowledge of and ability to generate simple equivalent fractions (3NF3b)** **4.NF.2** Compare two fractions in Nemeth Braille Code with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as ½. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with Nemeth Braille Code symbols >, =, <, and justify the conclusions, e.g., by using a **visual fraction model**. **(SC 4)** **Essential Skills and Knowledge** • **Ability to apply knowledge factors (4OA4) to the strategies used to determine equivalent fractions as well as ordering fractions** • **Ability to apply reasoning such as 5/20 < 1 /2 because 5 is not half of 20** • **Ability to compare unlike fractions as stated in this Standard lays the foundation for knowledge of strategies such as finding the Least Common**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers	**Multiple or the Greatest Common Factor** **4.NF.3** Understand a fraction *a/b* with *a > 1* as a sum of fractions *1/b* using Nemeth Braille Code **Essential Skills and Knowledge** • **See 4NF3a-4NF3d for the skills and knowledge that are needed for this Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
	4.NF.3a Understand addition and subtraction of fractions using Nemeth Braille Code as joining and separating parts referring to the same whole **Essential Skills and Knowledge** • **Ability to use concrete and/or tactile graphics of pictorial tools to add and subtract fractions with like denominators** • **Knowledge that the numerator tells how many parts of the whole we are counting and the denominator tells how many total parts there are in all** • **Knowledge that when counting parts of a whole, the numerator consecutively changes, the denominator stays the same (Example, 1/4, 2/4, 3/4, 4/4 or 1)** • **Ability to use manipulatives to demonstrate that the denominator does not change when adding or subtracting fractions with like denominators** • **Ability to represent the addition and subtraction of fractions using concrete materials, pictures, numbers, and words**	

GRADE 4

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	4.NF.3b **Decompose** a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition as an equation in Nemeth Braille Code. Justify decompositions, e.g., by using a visual fraction model. *Examples: 3/8 = 1/8 + 1/8 + 1/8; 3/8 = 1/8 + 2/8; 2 1/8 = 1 + 1+ 1/8; 2 1/8 = 8/8 + 8/8 + 1/8.* **Essential Skills and Knowledge** • **Ability to represent a whole number as a fraction (e.g.: 1 = 7/7, 8/8, etc)** • **Ability to decompose fractions greater than one into whole numbers and fractional parts (3NF3c)** **4.NF.3c** Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using Nemeth Braille Code, **properties of operations** and the relationship between addition and subtraction. **(SC 4)** **Essential Skills and Knowledge** • **Ability to change a mixed number into an improper fraction** • **Ability to add mixed numbers using a strategy such as adding fractions together and then adding the whole numbers together** • **Ability to subtract mixed numbers using a strategy such as replacing each mixed number with an equivalent fraction and then subtracting**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	4.NF.3d Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using tactile representations/visual fraction models and equations in Nemeth Braille Code to represent the problem. **Essential Skills and Knowledge** • **Ability to apply the understanding that the numerator tells us how many parts of the whole we are counting and the denominator tells us how many total parts there are** **4.NF.4** Apply and extend previous understandings of multiplication to multiply a fraction by a whole number using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to use concrete materials to model multiplication of fractions** • **Knowledge that when multiplying a whole number by a fraction, you are finding that fractional part of the whole number (e.g.: ¼ x 24 is the same as ¼ of 24** • **Ability to connect the multiplication of fractions to the repeated addition of fractions (e.g.: 4 x 2/4 = 2/4 + 2/4 + 2/4 + 2/4)**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	4.NF.4a Understand a fraction *a/b* as a multiple of *1/b*. *For example, use a tactile graphics/visual fraction model to represent 5/4 as the product of 5 x (1/4), recording the conclusion by the equation 5/4 = 5 x (1/4) in Nemeth Braille Code.* **Essential Skills and Knowledge** • **Ability to apply the concept of a unit fraction in relationship to a multiple of that fraction (e.g.: 1/4 is the unit fraction of fourths)** **4.NF.4b** Understand a multiple of *a/b* as a multiple of *1/b, and use this understanding to multiply a fraction by a whole number. For example, use a visual fraction model to express 3 x (2/5) as 6 x (1/5), recognizing this product as 6/5. (In general, n x (a/b) = (n x a)/b.)using Nemeth Braille Code.* **Essential Skills and Knowledge** • **Knowledge that 3 x 2/5 = 3 groups of 2/5 or 2/5 + 2/5 +2/5**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	4.NF.4c Solve word problems involving multiplication of a fraction by a whole number, e.g., by using tactile graphics /visual fraction models and equations in Nemeth Braille Code to represent the problem. *For example, if a person at a party will eat 3/8 of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?* **Essential Skills and Knowledge** • **Ability to apply knowledge of multiplication of fractions by a whole number to a variety of real life problem situations**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Understand decimal notation for fractions, and compare decimal fractions.	**4.NF.5** Express a fraction in Nemeth Braille Code with denominator 10 as an **equivalent fraction** with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100. *For example, express 3/10 as 30/100, and add 3/10 + 4/100 = 34/100.* **(SC 4)** **Essential Skills and Knowledge** • **Knowledge of this Standard provides a foundation for the relationship between fractions and decimals** **4.NF.6** Use decimal notation for fractions in Nemeth Braille Code with denominators 10 and 100. *For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line in Nemeth Braille Code ~~diagram~~.* **(SC 4)** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	

GRADE 4

DOMAIN: Number and Operations – Fractions		
Cluster	**Standard**	**Mathematical Practices**
	4.NF.7 Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons in Nemeth Braille Code with the symbols >, =, <, and justify the conclusions, e.g., by using a tactile graphic/visual model. **Essential Skills and Knowledge** • **Ability to apply knowledge of place value as a strategy to compare decimals**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
Solve problems involving measurement and conversion of measurements for a larger unit to a smaller unit.	**4.MD.1** Know relative sizes of measurement units within one system of units including km, m, cm, kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table in Nemeth Braille Code. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), 3, 36), …* **(SC 4)** Read a braille table that contains top/bottom box lines, line after heading, and guide dots. **Essential Skills and Knowledge** • **Knowledge of capacity units should also include cups, pints, quarts, and gallons.** • **Knowledge of length units should also include inches, feet, and yards.** • **Ability to use tactile graphics /visual aids with conversion of measurement** **4.MD.2** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Express equations, solutions, and written responses in Nemeth Braille Code. Represent measurement quantities using tactile diagrams, such as a Nemeth Braille Code number lines ~~diagrams~~ that features a measurement scale.	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	Essential Skills and Knowledge • **Ability to use tactile graphics of visual aids with conversion of measurement** • **Knowledge of systems of measurement, fractions, decimals, and equivalent units of measurement** **4.MD.3** Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formulas as a multiplication equation with an unknown factor.* **(SC 4)** **Essential Skills and Knowledge** • **Ability to apply knowledge of the relationship between area and perimeter through the exploration of rectangles with the same area but different perimeters or rectangles with the same perimeter but different areas** • **Ability to apply knowledge of factors, finding an unknown factor in an equation, and the relationship between multiplication and area**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**
Represent and interpret data.	**4.MD.4** Make a **line plot** to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8) using Nemeth Braille Code. Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.* **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	

GRADE 4

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
Geometric measurement: understand concepts of angle and measure angles.	**4.MD.5** Recognize tactile graphics of angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement. **(SC 4)** **Essential Skills and Knowledge** • **See 4MD5a-4MD5b for the skills and knowledge that are needed for this Standard.** **4.MD.5a** An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of the circle is called a "one-degree angle," and can be used to measure angles. Using tactile graphics, tactile tools, and a braille protractor, the student will measure and draw angles. The student will write in degrees in Nemeth Braille Code. **Essential Skills and Knowledge** • **Knowledge of partitioning circles into equal shares (2G3)** • **Ability to relate understanding of equal shares of a circle to angles** • **Ability to use visual aids and/or technology to apply the understanding of how a circle is divided into 360 degrees (e.g., circle protractor or accessible geometry software when developed)** • **Introduce the unit of measurement of a circle (degrees). Students need to understand that a whole circle is 360 degrees by taking a circle and dividing it into ½, ¼, 1/8, etc. so that ½ is 360**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	divided by 2, ¼ is 360 divided by 4, etc. **4.MD.5b** An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees. **Essential Skills and Knowledge** • **Knowledge that each angle measure is a result of how much of the circle is covered (e.g., shading in 50 parts of the 360 would equal a 50 degree angle)** **4.MD.6** Measure angles in whole-number degrees using a braille protractor. Sketch angles of specified measure with tactile tools. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard** **4.MD.7** Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure. Read and write angle measures (e.g., ∠ABC) using Nemeth Braille Code symbols and format. **Essential Skills and Knowledge** • **Ability to apply knowledge of common whole number addition and subtraction situations to fractional problem situations (CCSS, Page 88, Table 1)** • **Ability to use manipulatives to model the solution to the problem**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Draw and identify lines and angles, and classify shapes by properties of their lines and angles.	**4.G1** Draw **points**, **lines**, **line segments**, **rays**, **angles (right, acute, obtuse)**, **and perpendicular and parallel lines using tactile tools, a braille protractor, and a braille ruler** . Identify these in a tactile graphic of **two-dimensional figures**. Read and write signs for point, line, line segment, ray, angle, perpendicular, and parallel using Nemeth Braille Code symbols and format. **(SC 4)** **Essential Skills and Knowledge** • **This is the first time these terms are introduced** • **Ability to apply a deep understanding of this vocabulary will assist with drawing and identifying these shapes within two-dimensional figures** **4.G.2** Classify tactile graphics of two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify tactile graphics of right triangles. **Essential Skills and Knowledge** • **Ability to use concrete materials to model the lines and angles of two-dimensional figures to provide visual evidence of the relationship between various figures**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 4

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
	4.G.3 Recognize a **line of symmetry** for a tactile graphic of a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry using tactile tools. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard** • **This is the first exposure to symmetry in the Common Core**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
Write and interpret numerical expressions.	**5.OA.1** Use Nemeth Braille Code parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. **Essential Skills and Knowledge** • **Ability to build on knowledge of order of operations (3.OA.8) to find the value of an expression without variables** **5.OA.2** Write simple expressions in Nemeth Braille Code that record calculations with numbers, and interpret numerical expressions without evaluating them. For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Analyze patterns and relationships	**5.OA.3** Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns using Nemeth Braille Code, and graph the ordered pairs on a tactile graphic of a coordinate plane. For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.	

GRADE 5

DOMAIN: Operations and Algebraic Thinking		
Cluster	**Standard**	**Mathematical Practices**
	Essential Skills and Knowledge • **Knowledge that corresponding terms are used to create ordered pairs.** • **Ability to apply knowledge of the coordinate system.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Numbers and Operation in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
Understand the place value system	**5.NBT.1** Recognize that in a multi-digit number in Nemeth Braille Code, a digit in one place represents 10 times as much as it represents in the place to its right and $\frac{1}{10}$ of what it represents in the place to its left. **Essential Skills and Knowledge** • **Ability to build on experience with whole numbers and decimals within the base 10 system. (4.NBT.1)** **5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole number exponents to denote powers of 10. Use Nemeth Braille Code symbol for decimal point. Use Nemeth Braille Code superscript level indicator to create an exponent. Use Nemeth Braille Code baseline indicator, as needed. **Essential Skills and Knowledge** • **Knowledge of exponents with powers of 10.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Numbers and Operation in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	5.NBT.3 Read, write, and compare decimals in Nemeth Braille Code to thousandths. **a.** Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., 347.392 = 3 × 100 + 4 × 10 + 7 × 1 + 3 × ($\frac{1}{10}$) + 9 × ($\frac{1}{100}$) + 2 × ($\frac{1}{1000}$). **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **b.** Compare two decimals to thousandths based on meanings of the digits in each place, using Nemeth Braille Code >, =, and < symbols to record the results of comparisons. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **5.NBT.4** Use place value understanding to round decimals to any place. **SC 5** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Perform operations with multi-digit whole numbers and with decimals to hundredths.	**5.NBT.5** Fluently multiply multi-digit whole numbers using the standard algorithm and Nemeth Braille Code. **SC 5** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	

GRADE 5

DOMAIN: Numbers and Operation in Base Ten		
Cluster	**Standard**	**Mathematical Practices**
	5.NBT.6 Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, <u>and tactile representations of</u> rectangular arrays, and/or area models. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or <u>tactile graphics of</u> drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. **Essential Skills and Knowledge** • **Ability to recognize that the product is not always larger than its factors** • **Ability to recognize that the quotient is not always smaller than the dividend**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Number and Operations—Fractions		
Cluster	**Standard**	**Mathematical Practices**
Use equivalent fractions as a strategy to add and subtract fractions.	**5.NF.1** Add and subtract fractions with unlike denominators (including mixed numbers) using Nemeth Braille Code by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. For example, $\frac{2}{3}+\frac{5}{4}=\frac{8}{12}+\frac{15}{12}=\frac{23}{12}$. (In general, $\frac{a}{b}+\frac{c}{d}=\frac{(ad+bc)}{bd}$) **SC 5** **Essential Skills and Knowledge** • **Ability to create equivalent fractions for each addend by using the identity property.** **5.NF.2** Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using ~~visual~~ tactile fraction models or equations using Nemeth Braille Code to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. For example, recognize an incorrect result $\frac{2}{5}+\frac{1}{2}=\frac{3}{7}$ by observing that $\frac{3}{7}<\frac{1}{2}$. **Essential Skills and Knowledge** • **Knowledge of understanding addition and subtraction of fractions as joining and separating parts referring to the same whole. (4.NF.3a).**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Number and Operations—Fractions		
Cluster	**Standard**	**Mathematical Practices**
Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	**5.NF.3** Interpret a fraction as division of the numerator by the denominator ($\frac{a}{b} = a \div b$) using Nemeth Braille Code. Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using ~~visual~~ tactile fraction models or equations to represent the problem. For example, interpret $\frac{3}{4}$ as the result of dividing 3 by 4, noting that $\frac{3}{4}$ multiplied by 4 equals 3 and that when 3 wholes are shared equally among 4 people each person has a share of size $\frac{3}{4}$. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie? **Essential Skills and Knowledge** • **Ability to recognize that a fraction is a representation of division.** **5.NF.4** Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. **a.** Interpret the product $(\frac{a}{b}) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. For example, use a ~~visual~~ tactile fraction model to show $(\frac{2}{3}) \times 4 = \frac{8}{3}$, and create a story context for this equation. Do the same with $(\frac{2}{3}) \times (\frac{4}{5}) = \frac{8}{15}$. (In general, $(\frac{a}{b}) \times (\frac{c}{d}) = \frac{ac}{bd}$.)	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Number and Operations—Fractions		
Cluster	**Standard**	**Mathematical Practices**
	Essential Skills and Knowledge • **See the skills and knowledge that are stated in the Standard.** **b.** Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas. **Essential Skills and Knowledge** • **Knowledge of unit fractions to multiply all fractions. (4.NF.3)** • **Knowledge of using rectangular arrays to find area using rational numbers. (4.NBT.5)** **5.NF.5** Interpret multiplication as scaling (resizing) by: **a.** Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **b.** Explaining why multiplying a given number by a fraction greater than one results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case);	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: Number and Operations—Fractions		
Cluster	**Standard**	**Mathematical Practices**
	explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $\frac{a}{b} = \frac{(n \times a)}{(n \times b)}$ to the effect of multiplying $\frac{a}{b}$ by 1. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **5.NF.6** Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using ~~visual~~ tactile fraction models or equations using Nemeth Braille Code to represent the problem **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **5.NF.7** Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement at this grade.) **a.** Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. For example, create a	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: Number and Operations—Fractions		
Cluster	**Standard**	**Mathematical Practices**
	story context for $(\frac{1}{3}) \div 4$ and use a ~~visual~~ tactile-fraction model to show the quotient. Use the relationship between multiplication and division to explain that $(\frac{1}{3}) \div 4 = \frac{1}{12}$ because $(\frac{1}{12}) \times 4 = \frac{1}{3}$. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **b.** Interpret division of a whole number by a unit fraction, and compute such quotients. For example, create a story context for $4 \div (\frac{1}{5})$ and use a ~~visual~~ -tactile fraction model to show the quotient. Use the relationship between multiplication and division to explain that $4 \div (\frac{1}{5}) = 20$ because $20 \times (\frac{1}{5}) = 4$. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **c.** Solve real-world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using ~~visual tactile~~ fraction models and equations to represent the problem. For example, how much chocolate will each person get if 3 people share $\frac{1}{2}$ lb of chocolate equally? How many $\frac{1}{3}$-cup servings are in 2 cups of raisins? **Essential Skills and Knowledge** • **Knowledge of the relationship between multiplication and division (4.NBT.6), (5.NF.7a), (5.NF.7b)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
Convert like measurement units within a given measurement system.	**5.MD.1** Using Nemeth Braille Code, convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step real world problems. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
Represent and interpret data.	**5.MD.2** Make a line plot using Nemeth Braille Code to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Use operations on fractions for this grade to solve problems involving information presented in line plots. For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally. **Essential Skills and Knowledge** • **Knowledge of whole numbers on a line plot to represent and interpret fractional data on a line plot.(4.MD.4)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.**
Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.	**5.MD.3** Recognize volume as an attribute of solid figures (of tactile graphics) and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. **Essential Skills and Knowledge** • See the skills and knowledge that are stated in the Standard	**4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.	**5.MD.4** Measure volumes by counting unit cubes in tactile graphics, using cubic cm, cubic in, cubic ft, and improvised units. **SC 5** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard** **5.MD.5** Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. **a.** Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent three-fold whole-number products as volumes, e.g., to represent the associative property of multiplication. **Essential Skills and Knowledge** • See the skills and knowledge that are stated in the Standard. **b.** Apply the formulas V =(l)(w)(h) and V = (b)(h) for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **c.** Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

DOMAIN: Measurement and Data		
Cluster	**Standard**	**Mathematical Practices**
	parts, applying this technique to solve real world problems. **Essential Skills and Knowledge** • **Knowledge that the volume of a prism is the area of the Base times the height.**	

GRADE 5

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Graph points on the coordinate plane to solve real-world and mathematical problems.	**5.G.1** Using tactile graphics of ~~Use~~ a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate). **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **5.G.2** Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane using a tactile graphics, and interpret coordinate values of points in the context of the situation. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **SC 5**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.**
Classify two-dimensional figures into categories based on their properties.	**5.G.3** Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles. **Essential Skills and Knowledge** • **Knowledge of classifying two dimensional figures (4.G.2) to see relationships among the attributes of two-dimensional figures.**	**7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 5

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
	5.G.4 Classify two-dimensional tactile graphics of figures in a hierarchy based on properties. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Ratios and Proportional Relationships		
Cluster	**Standard**	**Mathematical Practices**
Understand ratio concepts and use ratio reasoning to solve problems.	**6.RP.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes." **Essential Skills and Knowledge** • Knowledge of ratio as a comparison of any two quantities • Knowledge of a ratio is not always a comparison of part-to-whole; Can be part-to-part or whole-to-whole **6.RP.2** Understand the concept of a unit rate $\frac{a}{b}$ associated with a ratio, using Nemeth Braille Code symbol for ratio, a:b with b ≠ 0 (b not equal to zero), and use rate language in the context of a ratio relationship. For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $\frac{3}{4}$ cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger." (Expectations for unit rates in this grade are limited to non-complex fractions.) **Essential Skills and Knowledge** • **Knowledge that a unit rate emphasizes finding an equivalent ratio with a denominator of 1.** **6.RP.3** Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about Nemeth Braille Code tables of equivalent ratios, tactile graphics of tape diagrams, Nemeth Braille Code double number line diagrams, or Nemeth Braille Code equations. **a.** Make Nemeth Braille Code tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the tactile graphics of coordinate	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Ratios and Proportional Relationships		
Cluster	**Standard**	**Mathematical Practices**
Understand ratio concepts and use ratio reasoning to solve problems.	plane. Use Nemeth Braille Code tables to compare ratios. **Essential Skills and Knowledge** • **Knowledge of multiplicative recursive patterns** • **Ability to use multiplicative relationships to extend an initial ratio to equivalent ratios; When working backward, use the inverse operation (division).** • **Ability to recognize a linear relationship appears when the pairs are plotted on the tactile graphics of a coordinate plane** **b.** Solve unit rate problems expressed in Nemeth Braille Code, including those involving unit pricing and constant speed. For example, If it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed? **Essential Skills and Knowledge** • **Ability to use division to determine unit rate** **c.** Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means $\frac{30}{100}$ times the quantity) using Nemeth Braille Code solve problems involving finding the whole given a part and the percent. **Essential Skills and Knowledge** • **Ability to introduce percent as a special rate where a part is compared to a whole and the whole always has a value of 100** • **Ability to solve problems using equivalent ratios. (NOTE: Proportions are not introduced until Grade 7.) This is developing proportional reasoning without formal proportions.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning**

GRADE 6

DOMAIN: Ratios and Proportional Relationships		
Cluster	**Standard**	**Mathematical Practices**
	d. Use ratio reasoning in Nemeth Braille Code to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. **Essential Skills and Knowledge** • **Ability to expand ratio reasoning to units of measurement**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning**

GRADE 6

DOMAIN: The Number System		
Cluster	**Standard**	**Mathematical Practices**
Apply and extend previous understandings of multiplication and division to divide fractions by fractions.	**6.NS.1** Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. For example, create a story context for Nemeth Braille Code expression $\left(\frac{2}{3}\right) \div \left(\frac{3}{4}\right)$ and use a tactile representation of a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that $\left(\frac{2}{3}\right) \div \left(\frac{3}{4}\right) = \frac{8}{9}$ because $\frac{3}{4}$ of $\frac{8}{9}$ is $\frac{2}{3}$. (In general, $\left(\frac{a}{b}\right) \div \left(\frac{c}{d}\right) = \frac{ad}{bc}$. How much chocolate will each person get if 3 people share $\frac{1}{2}$ lb of chocolate equally? How many $\frac{3}{4}$-cup servings are in $\frac{2}{3}$ of a cup of yogurt? How wide is a rectangular strip of land with length $\frac{3}{4}$mi and area $\frac{1}{2}$ square mi? **Essential Skills and Knowledge** • **Ability to explore the concept that division breaks quantities into groups** • **Ability to emphasize that when dividing by a value that is less than one, the quotient is greater than the dividend** • **Ability to explore both the measurement concept and the partition concept of division of fractions** • **Ability to introduce the fact that the measurement concept uses repeated subtraction or equal groups.** • **Ability to explore the common denominator algorithm as a method of repeated subtraction.** • **Knowledge of partition concept focuses on "How much is one?"** • **Knowledge of algorithm $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$ (invert and multiply) is an extension of the partition concept.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: The Number System		
Cluster	**Standard**	**Mathematical Practices**
Compute fluently with multi-digit numbers and find common factors and multiples.	**6.NS.2** Fluently divide multi-digit numbers using the standard algorithm. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **6.NS.3** Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **6.NS.4** Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12, expressed in Nemeth Braille. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. For example, express 36 + 8 as 4 (9 + 2)), using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to build on student knowledge of and differentiate between factors and multiples (CC.4.OA4)** • **Ability to build on student knowledge of factor pairs of whole numbers (CC.4.OA4)** • **Ability to identify and differentiate between common factors and common multiples of 2 whole numbers**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: The Number System		
Cluster	**Standard**	**Mathematical Practices**
Apply and extend previous understandings of numbers to the system of rational numbers.	**6.NS .5** Understand that Nemeth Braille Code positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **6.NS.6** Extend Nemeth Braille Code number line diagrams and tactile graphics of coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. **a.** Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., –(–3) = 3, and that 0 is its own opposite, using Nemeth Braille Code symbols for a negative number. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **b.** Understand Nemeth Braille Code signs of numbers in ordered pairs as indicating locations in tactile representation of quadrants of the coordinate plane; recognize that when two Nemeth Braille Code ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes. **Essential Skills and Knowledge** • **Ability to introduce and define coordinate plane terminology, including coordinate plane and quadrants I, II, III, and IV**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: The Number System		
Cluster	**Standard**	**Mathematical Practices**
Apply and extend previous understandings of numbers to the system of rational numbers. **(continued)**	**c.** Find and position integers and other rational numbers on a Nemeth Braille Code of a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a tactile representation of a coordinate plane. **Essential Skills and Knowledge** • **Ability to include positive and negative fractions and decimals** • **Ability to introduce a scale on number lines and axes for rational numbers** **6.NS.7** Understand ordering and absolute value of rational numbers, using Nemeth Braille Code symbol for absolute value. **a.** Interpret statements of inequality as statements about the relative position of two numbers on a Nemeth Braille Code number line diagram. For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **b.** Write, interpret, and explain statements of order for rational numbers in real-world contexts. For example, write –3°C > –7°C , using Nemeth Braille Code to express the fact that –3°C is warmer than –7°C. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **c.** Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. For example, for an account balance of –30 dollars, write |–30| = 30 , using Nemeth Braille Code	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: The Number System		
Cluster	**Standard**	**Mathematical Practices**
	symbols for absolute value to describe the size of the debt in dollars. **Essential Skills and Knowledge** • **Ability to develop conceptual understanding to go beyond "absolute value always is positive".** **d.** Distinguish comparisons of absolute value from statements about order. For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars. **Essential Skills and Knowledge** • **Ability to develop understanding within real-world contexts** **6.NS.8** Solve real-world and mathematical problems by graphing points in all four quadrants of the tactile graphic of a coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Expressions and Equations		
Cluster	**Standard**	**Mathematical Practices**
Apply and extend previous understandings of arithmetic to algebraic expressions.	**6.EE.1** Write and evaluate Nemeth Braille Code expressions involving whole-number exponents. **Essential Skills and Knowledge** • **Ability to develop understanding of a whole-number exponent as shorthand for repeated multiplication of a number times itself** • **Ability to introduce squares and cubes first because they can be represented geometrically** • **Ability to extend understanding of order of operations to include exponents** **6.EE.2** Write, read, and evaluate expressions using Nemeth Braille Code in which letters stand for numbers. **a.** Write expressions using Nemeth Braille Code that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 – y. **Essential Skills and Knowledge** • **Ability to define what a variable is** • **Knowledge that there are multiple ways to read the same expression** **b.** Identify parts of an expression in Nemeth Braille Code using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. For example, describe the expression 2(8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms. **Essential Skills and Knowledge** • **Ability to introduce and define coefficient and term** • **Ability to read expressions aloud to explore the concept of quantities**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Expressions and Equations		
Cluster	**Standard**	**Mathematical Practices**
Apply and extend previous understandings of arithmetic to algebraic expressions. **(continued)**	**c.** Evaluate expressions in Nemeth Braille Code at specific values for their variables. Include expressions that arise from formulas in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). For example, use the formulas $V=s^3$ and $A=6s^2$ to find the volume and surface area of a cube with sides of length $s = \frac{1}{2}$. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **6.EE.3** Apply the properties of operations to generate equivalent expressions. For example, apply the distributive property to the Nemeth Braille Code expression 3(2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y. **Essential Skills and Knowledge** • **Ability to use properties of operations to simplify expressions, therefore producing equivalent expressions** **6.EE.4** Identify when two expressions in Nemeth Braille Code are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Construct viable arguments and critique the reasoning of others.** **2. Model with mathematics.** **3. Use appropriate tools strategically.** **4. Attend to precision.** **5. Look for and make use of structure.** **6. Look for and express regularity in repeated reasoning.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Expressions and Equations		
Cluster	**Standard**	**Mathematical Practices**
Reason about and solve one-variable equations and inequalities.	**6.EE.5** Understand solving an equation or inequality in Nemeth Braille Code as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **6.EE.6** Use variables to represent numbers and write expressions in Nemeth Braille Code when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **6.EE.7** Solve real-world and mathematical problems by writing and solving equations in Nemeth Braille Code of the form x + p = q and px = q for cases in which p, q and x are all nonnegative rational numbers. **Essential Skills and Knowledge** • **Ability to reinforce that solving equations is finding values of the variable that make the equation true** • **Ability to develop conceptual understanding of inverse operations** • **Ability to develop an understanding of how to apply properties of equality** • **Knowledge of preserving equivalence as you solve equations**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Expressions and Equations		
Cluster	**Standard**	**Mathematical Practices**
Reason about and solve one-variable equations and inequalities.	**6.EE.8** Write an inequality in Nemeth Braille Code of the form x > c or x < c to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form x > c or x < c have infinitely many solutions; represent solutions of such inequalities on number line diagrams. **Essential Skills and Knowledge** • **Ability to develop conceptual understanding of representing solutions to inequalities on a number line diagram** • **Knowledge of ≤ and ≥ in Nemeth Braille Code** • **Knowledge of symbolic components of the graph of an inequality; Specifically, open circle vs. closed circle, direction of shading using Nemeth Braille Code symbols** • **Knowledge that an open circle represents a value that is NOT actually part of the solution set** • **Knowledge that solutions to x >c or x<c are not just integers but also fractions and decimals.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning**

GRADE 6

DOMAIN: Expressions and Equations		
Cluster	**Standard**	**Mathematical Practices**
Represent and analyze quantitative relationships between dependent and independent variables.	**6.EE.9** Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation in Nemeth Braille Code to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using tactile graphs and Nemeth Braille Code tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time. **Essential Skills and Knowledge** • **Ability to differentiate between independent and dependent variables** • **Knowledge of the relationship between the two variables** • **Knowledge of terminology associated with graphing ordered pairs (5.OA.3)** • **Ability to write an equation based on a graph or a table**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
Solve real-world and mathematical problems involving area, surface area, and volume.	**6.G.1** Find area of tactile graphics of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems. **Essential Skills and Knowledge** • **Ability to combine triangles to create rectangles** • **Ability to partition quadrilaterals and polygons into all triangles or a combination of triangles and rectangles/squares** • **Knowledge of the base and height of a right triangle are the length and width of** a rectangle to discover the formula $A = \frac{bh}{2}$ **6.G.2** Find the volume of a tactile graphic of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = lwh$ and $V = Bh$ using Nemeth Braille Code to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **6.G.3** Draw polygons in the coordinate plane given coordinates for the vertices using tactile drawing tools; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard** **SC 6**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Geometry		
Cluster	**Standard**	**Mathematical Practices**
	6.G.4 Represent tactile graphics of three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Statistics and Probability		
Cluster	**Standard**	**Mathematical Practices**
Develop understanding of statistical variability	**6.SP.1** Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages. **Essential Skills and Knowledge** • **Ability to introduce and develop statistical reasoning** • **Ability to determine the difference between a statistical question and a non-statistical question** **6.SP.2** Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. **Essential Skills and Knowledge** • **Ability to develop conceptual understanding of the characteristics of a data set** • **Ability to develop an understanding of outliers** **6.SP.3** Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number **Essential Skills and Knowledge** • **Knowledge of median and mean as measures of center** • **Knowledge of range as a measure of variation** • **Ability to look at a set of data and estimate the measures of center**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 6

DOMAIN: Statistics and Probability		
Cluster	**Standard**	**Mathematical Practices**
Summarize and describe distributions.	**6.SP.4** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. **Essential Skills and Knowledge** • **Ability to recognize that a dot plot is a line plot using Nemeth Braille Code** • **Ability to recognize a histogram using a Nemeth Braille Code number line and tactile graphics for the data** • **Ability to recognize that a box plot is a box-and-whisker plot using a Nemeth Braille Code number line and tactile graphics for the box and whiskers** **6.SP.5** Summarize numerical data sets in relation to their context, such as by: **a.** Reporting the number of observations. • *See the skills and knowledge that are stated in the Standard.* **b.** Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. • **Knowledge of conceptual understanding of statistical interpretation, focusing on the context of data sets** **c.** Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data was gathered. • **Ability to identify data that are outliers and understand how they affect the measures of central tendency** **d.** Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data was gathered • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. 8. Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: RATIOS AND PROPORTIONAL RELATIONSHIPS (RP)		
Cluster	**Standard**	**Mathematical Practices**
Analyze proportional relationships and use them to solve real-world and mathematical problems.	**7.RP.1:** Compute **unit rates** associated with **ratios** of fractions, including ratios of lengths, areas and other quantities measured in like and or different units in Nemeth Braille Code. *For example, if a person walks* $\frac{1}{2}$ *mile in each* $\frac{1}{4}$ *hour, compute the unit rate as the* ***complex fraction*** $\frac{\frac{1}{2}}{\frac{1}{4}}$ *miles per hour, equivalently 2 miles per hour.* **Essential Skills and Knowledge** • **Ability to describe and identify complex fractions (see 7.NS.3)** • **Ability to recognize the difference(s) between a unit rate and a ratio (see 7.G.1)** **7.RP.2:** Recognize and represent **proportional relationships** between quantities in Nemeth Braille Code. **2a.** Decide whether two quantities are in a **proportional relationship**, e.g., by testing for equivalent ratios in a in Nemeth Braille Code table or graphing on a tactile graphic of a coordinate plane and observing whether the graph is a straight line through the origin. **Essential Skills and Knowledge** • **Ability to recognize in a given proportional situation that the two "between ratios" and the two "within ratios" are the same** • **Ability to distinguish between additive and multiplicative situations** • **Ability to recognize that two equal ratios represent a proportion** • **Ability to recognize and represent the connection between equivalent ratios, values in a table, and graphed ordered pairs (see 7.G.1)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: RATIOS AND PROPORTIONAL RELATIONSHIPS (RP)		
Cluster	**Standard**	**Mathematical Practices**
	2b. Identify the constant of proportionality (**unit rate**) in in Nemeth Braille Code tables, tactile graphics of graphs, Nemeth Braille Code equations, tactile graphics of diagrams and verbal descriptions of proportional relationships. **Essential Skills and Knowledge** • **Ability to express unit rates using a variety of representations, given a contextual situation**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.**
Analyze proportional relationships and use them to solve real-world and mathematical problems.	**2c.** Represent **proportional relationships** by equations in Nemeth Braille Code. *For example, if total cost t is proportional to the number of n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* **Essential Skills and Knowledge** • **Ability to recognize that multiplicative relationships are proportional** **2d.** Explain what a point (*x, y*) on the tactile graph of a **proportional relationship** means in terms of the situation, with special attention to the points (0, 0) and (1, *r*) where *r* is the unit rate. **Essential Skills and Knowledge** • **Ability to identify that a proportional relationship intersects (0,0)** • **Ability to determine other points using (1, r)** **7.RP.3**: Use **proportional relationships** to solve multistep ratio and percent problems using Nemeth Braille Code. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, **percent error**.* **Essential Skills and Knowledge** • **Ability to build on prior experience with equivalent fractions to solve multi-step problems with ratio and percent (see 6.RP.3c)** • **Ability to relate "between" ratios and "within" ratios to the cross-product and factor of change algorithms**	**3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: THE NUMBER SYSTEM (NS)		
Cluster	**Standard**	**Mathematical Practices**
Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	**7.NS.1:** Apply and extend previous understandings of addition and subtraction to add and subtract **rational numbers**, and represent addition and subtraction on a Nemeth Braille Code horizontal or **vertical number line** diagram. **1a.** Describe situations in which opposite quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.* **Essential Skills and Knowledge** • **Ability to build on prior experience with positive and negative rational numbers (see 6.NS.5)** • **Ability to identify additive inverses using rational numbers** • **Knowledge of positive or negative values for fractions and decimals** **1b.** Understand $p + q$ as the number located a distance $\|q\|$ from p, in the positive or negative direction depending on whether q is positive or negative in Nemeth Braille Code. Show that a number and its opposite have a sum of 0 (are **additive inverses**). Interpret sums of **rational numbers** by describing real-world contexts. **Essential Skills and Knowledge** • **Ability to build on prior experience with absolute value (see 6.NS.7)** • **Knowledge of absolute value to add and subtract rational numbers using a horizontal or a vertical number line** **1c.** Understand subtraction of rational numbers in Nemeth Braille Code as adding the **additive inverse**, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the **absolute value** of their difference, and apply this principle in real-world contexts. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: THE NUMBER SYSTEM (NS)		
Cluster	**Standard**	**Mathematical Practices**
	1d. Apply properties of operations as strategies to add and subtract **rational numbers** in Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to identify and apply the following properties:** ○ **Commutative Property of Addition** ○ **Associative Property of Addition** • **Identity Property of Addition**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.**
Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	**7.NS.2**: Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers in Nemeth Braille Code. **2a.** Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. **Essential Skills and Knowledge** • **Ability to identify and apply the following properties:** ○ **Multiplicative Inverse** ○ **Commutative Property of Multiplication** ○ **Associative Property of Multiplication** ○ **Identity Property of Multiplication** ○ **Recognize that rules for multiplying signed numbers remain the same for all rational numbers** **2b**. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If *p* and *q* are integers, then: $-\left(\frac{p}{q}\right) = \frac{-p}{q} = \frac{p}{-q}$ Interpret quotients of **rational numbers** by describing real-world contexts.	**3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
DOMAIN: THE NUMBER SYSTEM (NS)		

Cluster	Standard	Mathematical Practices
	Essential Skills and Knowledge • **Ability to explore and justify the result of division by 0 (zero)** • **Ability to apply and extend knowledge of addition and subtraction of integers (i.e., two color counters, arrows on a number line) to extend to multiplication and division** • **Ability to use patterns and concrete models to devise a general rule for dividing integers**: $-\left(\frac{p}{q}\right) = \frac{-p}{q} = \frac{p}{-q}$	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.**
Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	**2c.** Apply properties of operations as strategies to multiply and divide **rational numbers** in Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to Identify and apply the following properties:** ○ **Distributive Property** ○ **Associative Properties** ○ **Commutative Properties** ○ **Identity Properties** **2d.** Convert a **rational number** to a decimal using long division in Nemeth Braille Code; and know that the decimal form of a rational number terminates in 0s or eventually repeats. **Essential Skills and Knowledge** • **Ability to recognize that when rational numbers in fractional form are converted to decimals, they either terminate or repeat** **7NS.3:** Solve real-world and mathematical problems involving the four operations with **rational numbers** in Nemeth Braille Code. (Note: Computations with **rational numbers** extend the rules for manipulating fractions to **complex fractions**.) **Essential Skills and Knowledge** • **Ability to describe and identify complex fractions (see 7.RP.1)** • **Ability to apply knowledge of Order of Operations**	**3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)		
Cluster	**Standard**	**Mathematical Practices**
Use properties of operations to generate equivalent expressions.	**7.EE.1:** Apply properties of operations as strategies to add, subtract, **factor**, and **expand linear expressions** with rational coefficients using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to understand linear expression terminology: sum, difference, term, product, factor, quotient, coefficient** • **Ability to factor by using division to express a linear expression by its factors; i.e., 2x – 6 = 2(x – 3)** • **Ability to expand by using multiplication to rewrite the factors in a linear expression as a product; i.e., 5(x+ 12) = 5x + 60** **7.EE.2:** Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."* **Essential Skills and Knowledge** • **Ability to utilize Properties of Operations in order to rewrite expressions in different forms** using Nemeth Braille Code • **Ability to develop understanding of equivalent forms of numbers, their various uses and relationships, and how they apply to a problem**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)		
Cluster	**Standard**	**Mathematical Practices**
Solve real-life mathematical problems using numerical and algebraic expressions and equations.	**7.EE.3:** Solve multi-step real-life and mathematical problems posed with positive and negative **rational numbers** in any form (whole numbers, fractions, and decimals), using Nemeth Braille Code, using tools strategically; apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional $\frac{1}{10}$ of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar $9\frac{3}{4}$ inches long in the center of a door that is $27\frac{1}{2}$ inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.* **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.**
	7.EE.4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities using Nemeth Braille Code. **4a.** Using Nemeth Braille Code, solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific **rational numbers**; solve equations of these forms fluently; compare an **algebraic solution** to an **arithmetic solution**, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* **Essential Skills and Knowledge** • **Ability to differentiate between an algebraic solution and an arithmetic solution**	**5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)		
Cluster	**Standard**	**Mathematical Practices**
	4b. Using Nemeth Braille Code, solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers; graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.* **Essential Skills and Knowledge** • **Ability to develop correct usage of all four inequality symbols and related terminology (*at least*, *no more than*, etc.)** • **Ability to solve inequalities to determine the solution set**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: GEOMETRY (G)		
Cluster	**Standard**	**Mathematical Practices**
Draw, construct, and describe geometrical figures and describe the relationships between them.	**7.G.1:** Solve problems involving tactile graphics of scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale using tactile drawing tools. **Essential Skills and Knowledge** • **Ability to describe and identify ratios and proportions (see 7.RP.1 and 7.RP.2)** • **Ability to reproduce scale drawing at a different scale** **7.G.2:** Using tactile drawing tools, draw (freehand, with braille ruler and braille protractor, and with accessible technology when it becomes available) shapes with given conditions. Focus on constructing (drawing) triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **7.G.3:** Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids using tactile graphics. **Essential Skills and Knowledge** • **Ability to build on prior knowledge with 2-dimensional figures and 3-dimensional figures** • **Ability to differentiate between the characteristics of right rectangular prisms and right rectangular pyramids** • **Ability to compare the attributes of right rectangular prisms and right rectangular pyramids**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: GEOMETRY (G)		
Cluster	**Standard**	**Mathematical Practices**
Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.	**7.G.4**: Know the formulas for the **area and circumference of a circle** and use them to solve problems in Nemeth Braille Code; give an informal derivation of the relationship between the circumference and area of a circle. Use tactile graphics of a circle. **Essential Skills and Knowledge** • **Ability to identify and apply the vocabulary for a circle – radius, diameter, chord, circumference, center, pi (π) ≈3.14159 and $\frac{22}{7}$** • **Ability to use a near-parallelogram to discover the formula for area of a circle** **7.G.5:** Use facts about **supplementary**, **complementary**, **vertical**, and **adjacent angles** in a multi-step problem to write and solve simple equations in Nemeth Braille Code for an unknown angle in a tactile graphic of a figure. **(SC 7)** **Essential Skills and Knowledge** • **Ability to explore the relationship between the angles of intersecting lines and figures** **7.G.6:** Solve real-world and mathematical problems using Nemeth Braille Code involving area, volume and surface area of two- and three-dimensional tactile graphics of objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: STATISTICS AND PROBABILITY (SP)		
Cluster	**Standard**	**Mathematical Practices**
Use random sampling to draw inferences about a population.	**7.SP.1:** Understand that statistics can be used to gain information about a **population** by examining a **sample of the population**; generalizations about a **population** from a sample are **valid** only if the sample is representative of that **population**. Understand that **random sampling** tends to produce representative samples and support **valid inferences**. **Essential Skills and Knowledge** • **Ability to describe and identify population, sample of a population, random sampling, validity, reliability, invalid, inferences** **7.SP.2:** Use data from a **random sample** to draw **inferences** about a **population** with an unknown characteristic of interest. Generate multiple **samples** (or **simulated samples**) of the same size to gauge the **variation** in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.* **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.**
Draw informal comparative inferences about two populations.	**7.SP.3:** Informally assess the degree of ~~visual~~ overlap of two **numerical data distributions** with similar **variabilities**, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, mean height of players on the basketball team is 10 cm greater than mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a Nemeth Braille Code* ***dot plot****, the separation between the two distributions of heights is noticeable* **Essential Skills and Knowledge** • **Ability to describe and identify deviation, standard deviation, absolute deviation, measures of central tendency, measures of variability** • **Ability to build on prior experience with dot plots to compare/contrast data displayed on two dot plots (see 6.SP.4) and to make inferences from the data**	5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: STATISTICS AND PROBABILITY (SP)		
Cluster	**Standard**	**Mathematical Practices**
Draw informal comparative inferences about two populations.	**7.SP.4:** Use **measures of center** and **measures of variability** for numerical data from **random samples** using Nemeth Braille Code to draw informal comparative **inferences** about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.* **Essential Skills and Knowledge** • **Ability to determine which measure of central tendency is most appropriate for a given situation** • **Ability to use statistical findings to draw inferences about populations**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**
Investigate chance processes and develop, use, and evaluate probability models.	**7.SP.5:** Understand that the **probability** of a **chance event** is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A **probability** near 0 indicates an unlikely event, a probability around $\frac{1}{2}$ indicates an event that is neither unlikely nor likely, and a **probability** near 1 indicates a likely event. **Essential Skills and Knowledge** • **Ability to devise models where outcomes are equally likely versus not equally likely** **7.SP.6:** Approximate the **probability** of a chance event by collecting data on the chance process that produces it and observing its long-run **relative frequency**, and predict the approximate **relative frequency** given the **probability**. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.* **(SC 7)** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	

GRADE 7

DOMAIN: STATISTICS AND PROBABILITY (SP)		
Cluster	**Standard**	**Mathematical Practices**
Investigate chance processes and develop, use, and evaluate probability models. (continued)	**7.SP.7:** Develop a probability model and use it to find probabilities of events; compare probabilities from a model to observed frequencies; and if the agreement is not good, explain possible sources of the discrepancy. **7a.** Develop a **uniform probability model** by assigning equal **probability** to all **outcomes**, and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the **probability** that Jane will be selected and the **probability** that a girl will be selected.* **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **7b.** Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?* **Essential Skills and Knowledge** • **Ability to describe and identify possibility versus probability** **7.SP.8:** Find probabilities of compound events using organized lists and tables in Nemeth Braille Code, tactile graphics of tree diagrams, and simulation. **8a.** Understand that, just as with **simple events**, the probability of a **compound event** is the fraction of **outcomes** in the sample space for which the **compound event** occurs. **(SC 7)** **Essential Skills and Knowledge** • **Ability to compare simple events with compound events**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 7

DOMAIN: STATISTICS AND PROBABILITY (SP)		
Cluster	**Standard**	**Mathematical Practices**
	8b. Represent **sample spaces** for **compound events** using methods such as organized lists and tables in Nemeth Braille Code and tactile graphics of tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the **outcomes** in the **sample space** which compose the **event**. **(SC 7)** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.**
Investigate chance processes and develop, use, and evaluate probability models.	**8c.** Design and use a **simulation** to generate **frequencies** for **compound events** using Nemeth Braille Code. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?* **Essential Skills and Knowledge** • **Ability to use models and simulate a variety of events**	**3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: THE NUMBER SYSTEM (NS)		
Cluster	**Standard**	**Mathematical Practices**
Know that there are numbers that are not rational, and approximate them by rational numbers.	**8.NS.1:** Know that numbers that are not **rational** are called **irrational**. Understand informally that every number has a decimal expansion; for rational numbers show, using Nemeth Braille Code, that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number using Nemeth Braille Code. **Essential Skills and Knowledge** • **Knowledge of differences between rational and irrational** • **Knowledge of definition and description of rational and irrational** • **Ability to identify and provide examples of rational versus irrational numbers, of the real number system** using Nemeth Braille Code. **8.NS.2:** Use **rational** approximations of **irrational** numbers to compare the size of **irrational** numbers in Nemeth Braille Code, locate them approximately on a Nemeth Braille Code. number line diagram, and estimate the value of expressions (e.g., π^2) using Nemeth Braille Code. *For example, by **truncating** the decimal expansion of* $\sqrt{2}$, using Nemeth Braille Code, *show that* $\sqrt{2}$ *is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.* **Essential Skills and Knowledge** • **Ability to round to the hundredths place** • **Ability to use a Nemeth Braille Code number line that specifies in tenths and hundredths the value between two whole numbers** • **Ability to use a Nemeth Braille Code number line that extends indefinitely, such as** π	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)		
Cluster	**Standard**	**Mathematical Practices**
Work with radicals and integer exponents.	**8.EE.1:** Know and apply the **properties of integer exponents** to generate equivalent numerical expressions using Nemeth Braille Code. *For example,* $3^2 \times 3^{-5} = 3^{-3} = \frac{1}{3^3} = \frac{1}{27}$ **Essential Skills and Knowledge** • **Ability to recognize and apply the following properties of integer exponents:** ○ **Product/Quotient of Powers** ○ **Negative Exponents** ○ **Zero Exponents** ○ **Power of Powers** • **Ability to apply a combination of properties to show equivalency** **8.EE.2:** Use square root and cube root symbols in Nemeth Braille Code to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive **rational** number. Using Nemeth Braille Code, evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is **irrational**. **Essential Skills and Knowledge** • **Ability to recognize and apply the following:** ○ **Perfect Squares** ○ **Perfect Cubes** ○ **Square Roots (Symbol Notation using Nemeth Braille Code)** ○ **Cube Roots (Symbol Notation using Nemeth Braille Code)** ○ **Principal (positive) roots/negative roots** • **Ability to recognize and use inverse relationships of squares with square roots and of cubes with cube roots using Nemeth Braille Code** **8.EE.3:** Use numbers expressed in the form of a single digit times an **integer power of 10** using Nemeth Braille Code to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger.* **Essential Skills and Knowledge** • **Ability to compare large and small numbers using** in Nemeth Braille Code **properties of integer exponents (see 8.EE.1)**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)		
Cluster	**Standard**	**Mathematical Practices**
Work with radicals and integer exponents.	**8.EE.4:** Perform operations with numbers expressed in **scientific notation** using Nemeth Braille Code, including problems where both **decimal** and scientific notation are used. Use **scientific notation** and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by accessible technology. **Essential Skills and Knowledge** • **Ability to compare units of measure** • **Ability to read scientific notation on an accessible calculator**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Understand the connections between proportional relationships, lines, and linear equations.	**8.EE.5:** Graph proportional relationships using Nemeth Braille Code and tactile drawing tools, interpreting the **unit rate** as the **slope** of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time tactile graph to a distance-time using Nemeth Braille Code equation to determine which of two moving objects has greater speed.* **Essential Skills and Knowledge** • **Ability to relate and compare graphic, symbolic, numerical representations of proportional relationships** • **Ability to calculate constant rate of change/slope of a line graphically using tactile graphics** • **Ability to understand that all proportional relationships start at the origin** • **Ability to recognize and apply direct variation** **8.EE.6:** Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the tactile graphic of a coordinate plane; using Nemeth Braille Code, derive the equation $y = mx$ for a line through the origin, and the equation $y = mx + b$ for a line intercepting the vertical axis at b.	

GRADE 8

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)		
Cluster	**Standard**	**Mathematical Practices**
	Essential Skills and Knowledge **Using tactile graphics,** • **Ability to understand that similar right triangles *(provide diagram of graphical notation)* can be used to establish that slope is constant for a non-vertical line (see 8.G.1)** • **Ability to graphically derive equations *y = mx* and *y = mx + b*** • **Ability to differentiate between zero slope and undefined slope** • **Ability to understand how the y-intercept translates a line along the y-axis (families of graphs)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Analyze and solve linear equations and pairs of simultaneous linear equations.	8.EE.7: Solve linear equations in one variable using Nemeth Braille Code **7a.** Using Nemeth Braille Code, give examples of linear equations in one variable with **one solution**, **infinitely many solutions**, or **no solutions**. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an **equivalent equation** of the form $x = a$, $a = a$, or $a = b$ results (a and b are different numbers). **Essential Skills and Knowledge** • **Ability to build on prior knowledge of solving linear equations (see 7.EE.4)** **7b.** Using Nemeth Braille Code, solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the **distributive property** and **collecting like terms**. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	

GRADE 8

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)		
Cluster	**Standard**	**Mathematical Practices**
	8.EE.8: Analyze and solve pairs of simultaneous linear equations using Nemeth Braille Code **8a.** Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. **Essential Skills and Knowledge** • **Ability to solve systems of equations numerically using Nemeth Braille Code or by graphing using tactile drawing tools** **8b.** Solve systems of two linear equations in two variables algebraically using Nemeth Braille Code, and estimate solutions by graphing the equations using tactile drawing tools. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.* **Essential Skills and Knowledge** • **Ability to solve systems of two linear equations in two variables algebraically using Nemeth Braille Code using substitution or elimination** • **Ability to discuss efficient solution methods with a system of equations - graphically using tactile drawing tools and algebraically using Nemeth Braille Code** • **Ability to solve simple cases by inspection, one solution, infinitely many solutions, or no solution.** **8c.** Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.* **Essential Skills and Knowledge** • **Ability to write an equation given in Nemeth Braille Code two points** • **Ability to write equations from context in Nemeth Braille Code** • **Ability to interpret the solution to a system of equations in context in Nemeth Braille Code**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: FUNCTIONS (F)		
Cluster	**Standard**	**Mathematical Practices**

Define, evaluate, and compare functions.	**8.F.1:** Understand that a **function** is a rule that assigns to each input exactly one output. The **graph of a function** is the set of ordered pairs consisting of an input and the corresponding output (**function notation** is not required in Grade 8).
	Essential Skills and Knowledge
	• **Ability to recognize functional relationships and apply the following in Nemeth Braille Code:**
	  ○ **Function Tables**
	  ○ **Vertical Line Test**
	  ○ **Domain/Input/Independent (x-coordinate)**
	  ○ **Range/Output/Dependent (y-coordinate)**
	
	8.F.2: Compare properties of two functions each represented in a different way (algebraically in Nemeth Braille Code, graphically using tactile drawing tools, numerically in Nemeth Braille Code tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*
	Essential Skills and Knowledge
	• **Ability to compare properties – constant rate of change/slope, increasing, decreasing, y-intercept, parallel lines, slopes of horizontal/vertical lines (see 8.EE.5 and 8.EE.6)**
	• **Ability to calculate slope/rate of change of a line graphically from a table in Nemeth Braille Code, or verbal description**
	• **Ability to determine y-intercept from a Nemeth Braille Code table, equation, tactile graph, or verbal description**
		1. **Make sense of problems and persevere in solving them.**
		2. **Reason abstractly and quantitatively.**
		3. **Construct viable arguments and critique the reasoning of others.**
		4. **Model with mathematics.**
		5. **Use appropriate tools strategically.**
		6. **Attend to precision.**
		7. **Look for and make use of structure.**
		8. **Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: FUNCTIONS (F)		
Cluster	**Standard**	**Mathematical Practices**
	8.F.3: Interpret the equation $y = mx + b$ in Nemeth Braille Code, as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = S^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1, 1), (2, 4) and (3, 9), which are not on a straight line.* **(SC 8)** **Essential Skills and Knowledge** • **Ability to distinguish between linear and non-linear functions using Nemeth Braille Code and tactile graphics** • **Ability to identify and define independent variables and dependent variables in equations in Nemeth Braille Code, that represent authentic scenarios**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: FUNCTIONS (F)		
Cluster	**Standard**	**Mathematical Practices**
Use functions to model relationships between quantities.	**8.F.4:** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x*, *y*) values, including reading these from a Nemeth Braille Code table or from a tactile graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. **Essential Skills and Knowledge** • **Ability to calculate and interpret constant rate of change /slope from a scenario, table, graph, or two points** • **Ability to calculate and interpret initial value (y-intercept) from a scenario, graph, or table** • **Ability to represent linear relationships numerically, graphically (table), and algebraically (equation)** **8.F.5:** Describe qualitatively the **functional relationship** between two quantities by analyzing a tactile graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph, using tactile drawing tools, that exhibits the qualitative features of a function that has been described verbally. **Essential Skills and Knowledge** • **Ability to distinguish rate of change within an interval of a function** • **Ability to interpret directionality and steepness of the graph of a function** • **Ability to sketch a graph given algebraic context or a scenario (slope and initial value)** • **Ability to create a plausible story given a graph**	**1 . Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: GEOMETRY (G)		
Cluster	**Standard**	**Mathematical Practices**
Understand congruence and similarity using physical models, transparencies, or geometry software.	**8.G.1:** Verify experimentally the properties of **rotations**, **reflections,** and **translations** in tactile graphics. **1a.** Lines are taken to lines, and line segments to line segments of the same length. **Essential Skills and Knowledge** • **Ability to conduct experiments which show that rotations, reflections, and translations of tactile graphics of lines and line segments are rigid** • **Ability to use transformation notation (A → A' → A") in Nemeth Braille Code** • **Ability to use tactile graphics of physical models and accessible software when developed to demonstrate transformations** **1b.** Angles **are taken to** angles of the same measure. **Essential Skills and Knowledge** • **Ability to conduct experiments which show that rotations, reflections, and translations of tactile graphics of angles are rigid** • **Ability to use transformation notation (∠A → ∠A' → ∠A") in Nemeth Braille Code** • **Ability to use tactile graphics of physical models and accessible software when developed to demonstrate transformations** **1c.** Parallel lines **are taken to** parallel lines. **Essential Skills and Knowledge** • **Ability to conduct experiments which show that rotations, reflections, and translations of tactile graphics of parallel lines are rigid** • **Ability to use transformation notation (A → A' → A") in Nemeth Braille Code** • **Ability to use tactile graphics of physical models and accessible software when developed to demonstrate transformations**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: GEOMETRY (G)		
Cluster	**Standard**	**Mathematical Practices**
Understand congruence and similarity using physical models, transparencies, or geometry software.	**8.G.2:** Understand that a tactile graphic of a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two tactile graphics of congruent figures, describe a sequence that exhibits the congruence between them. **Essential Skills and Knowledge** • **Ability to use a sequence of transformations and map one figure to a second figure to show congruency and write in Nemeth Braille Code** • **Ability to describe a sequence of transformations, needed to generate the image, given its pre-image** **8.G.3:** Describe the effect of dilations, translations, rotations, and reflections on tactile graphics of two-dimensional figures using coordinates. **Essential Skills and Knowledge** • **Ability to verbally describe the location on a coordinate grid of an image with respect to the pre-image** • **Ability to extend with algebraic rules of transformations in Nemeth Braille Code** • **Ability to write algebraic rules in Nemeth Braille Code for transformations given an image and pre-image on coordinate plane, using multiple transformations** • **Ability to discuss the difference between rigid and non-rigid transformations**	1. **Make sense of problems and persevere in solving them.** 2. **Reason abstractly and quantitatively.** 3. **Construct viable arguments and critique the reasoning of others.** 4. **Model with mathematics.** 5. **Use appropriate tools strategically.** 6. **Attend to precision.** 7. **Look for and make use of structure.** 8. **Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: GEOMETRY (G)		
Cluster	**Standard**	**Mathematical Practices**
Understand congruence and similarity using physical models, transparencies, or geometry software.	**8.G.4:** Understand that a tactile graphic of a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar tactile graphics of two-dimensional figures, describe a sequence that exhibits the similarity between them. **Essential Skills and Knowledge** • **Ability to use a sequence of transformations, and to map one figure to a second to show similarity and write in Nemeth Braille Code** • **Ability to show that similar figures maintain shape but alter size through dilation (scale factor)** • **Ability to demonstrate that congruency is a special case of similarity (scale factor of 1)** • **Ability to describe the sequence of transformations needed to generate an image, given its pre-image** **8.G.5:** Use informal arguments to establish facts about the **angle sum** and **exterior angle of** tactile graphics of **triangles**, about the angles created when **parallel lines are cut by a transversal** in tactile graphics, and the **angle-angle criterion for similarity of** tactile graphics of **triangles**. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* **Essential Skills and Knowledge** • **Ability to use and apply facts that result from parallel lines cut by a transversal**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: GEOMETRY (G)		
Cluster	**Standard**	**Mathematical Practices**
Understand and apply the Pythagorean Theorem.	**8.G.6:** Explain a **proof of the Pythagorean Theorem** and its **converse**. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **8.G.7:** Apply the **Pythagorean Theorem** to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions using tactile graphics and Nemeth Braille Code. **(SC 8)** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **8.G.8:** Apply the **Pythagorean Theorem** to find the distance between two points in a coordinate system using tactile graphics and Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to derive the distance formula from the Pythagorean Theorem, using the hypotenuse of a triangle**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	**8.G.9:** Know the formulas for the **volumes of cones**, **cylinders,** and **spheres** and use them to solve real-world and mathematical problems using tactile graphics and Nemeth Braille Code. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	

GRADE 8

DOMAIN: STATISTICS AND PROBABILITY (SP)		
Cluster	**Standard**	**Mathematical Practices**
Investigate patterns of association in bivariate data.	**8.SP.1: Construct and interpret** tactile graphics of **scatter plots** for **bivariate measurement data** to investigate patterns of association between two quantities. Describe patterns such as **clustering**, **outliers**, **positive or negative association**, **linear association**, and **nonlinear association**. **Essential Skills and Knowledge** • **Ability to integrate accessible technology when developed and relate the scenarios to authentic student-centered situations** • **Ability to keep paired data organized in relation to one another within two sets of quantities using Nemeth Braille Code.** **8SP2:** Know that straight lines are widely used to model relationships between two quantitative variables. For tactile graphics of scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** **8.SP.3:** Use the **equation of a linear model** in Nemeth Braille Code to solve problems in the context of **bivariate measurement data**, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.* **Essential Skills and Knowledge** • **Ability to integrate accessible technology when developed and to relate the scenarios to authentic student-centered situations**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3.Construct viable arguments and critique the reasoning of others.** **4. Model withnmathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

GRADE 8

DOMAIN: STATISTICS AND PROBABILITY (SP)		
Cluster	**Standard**	**Mathematical Practices**
Investigate patterns of association in bivariate data.	**8.SP.4:** Understand that patterns of association can also be seen in **bivariate categorical data** by displaying **frequencies** and **relative frequencies** in a **two-way table** using Nemeth Braille Code. Construct and interpret a **two-way table** using Nemeth Braille Code summarizing data on two **categorical variables** collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?* **Essential Skills and Knowledge** • **Ability to integrate accessible technology when developed and to relate the scenarios to authentic student-centered situations**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

ALGEBRA I

Unit 1: Relationships between Quantities and Reasoning with Equations

By the end of eighth grade students have learned to solve linear equations in one variable and have applied graphical and algebraic methods to analyze and solve systems of linear equations in two variables. This unit builds on these earlier experiences by asking students to analyze and explain the process of solving an equation. Students develop fluency writing, interpreting, and translating between various forms of linear equations and inequalities, and using them to solve problems. They master the solution of linear equations and apply related solution techniques and the laws of exponents to the creation and solution of simple exponential equations. All of this work is grounded on understanding quantities and on relationships between them.

Unit 1: Relationships between Quantities and Reasoning with Equations		
Cluster	**Standard**	**Practices**
Reason quantitatively and use units to solve problems.	N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in tactile graphs and data displays. ★ **Note**: Working with quantities and the relationships between them provides the ground work for working with expressions, equations, and functions. **Essential Skills and Knowledge** • **Ability to choose appropriate units of measure to represent context of the problem** • **Ability to convert units of measure using dimensional analysis** N.Q.2 Define appropriate quantities for the purpose of **descriptive modeling** using Nemeth Braille Code and tactile graphs. **Essential Skills and Knowledge** • **Ability to select and use units of measure to accurately model a given real world scenario** N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **Essential Skills and Knowledge** • **Knowledge of and ability to apply rules of significant digits** • **Ability to use precision of initial measurements to determine the level of precision with which answers can be reported**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to recision.** **Look for and make use of structure.** **Look for and Express regularity in repeated reasoning.**

ALGEBRA I

Unit 1: Relationships between Quantities and Reasoning with Equations		
Cluster	**Standard**	**Practices**
Interpret the structure of expressions.	**Cluster Note: Limit to linear expressions and to exponential expressions with <u>integer</u> exponents.** **Note: These are overarching standards that have applications in multiple units.** A.SSE.1 Interpret expressions <u>in Nemeth Braille Code</u> that represent a quantity in terms of its context. a. Interpret parts of an expression <u>in Nemeth Braille Code</u>, such as terms, factors, and coefficients. **Essential Skills and Knowledge** • **Ability to make connections between symbolic representations and proper mathematics vocabulary** • **Ability to identify parts of an expression such as terms, factors, coefficients, etc.** b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.* **Essential Skills and Knowledge** • **Ability to interpret and apply rules for order of operations**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA I

Unit 1: Relationships between Quantities and Reasoning with Equations		
Cluster	**Standard**	**Practices**
Create equations that describe numbers or relationships.	A.CED.1 Create equations and inequalities using Nemeth Braille Code in **one** variable and use them to solve problems. (*Include equations arising from **linear** and quadratic functions, and simple rational and **exponential** functions.)* **Note**: Limit to linear and exponential relationships, and, in the case of exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs. **Essential Skills and Knowledge** • **Ability to distinguish between linear and exponential relationships given multiple representations and then create the appropriate equation/inequality using given information** A.CED.2 Create equations using Nemeth Braille Code in **two or more** variables to represent relationships between quantities; graph equations on tactile graphics of coordinate axes with labels and scales. **Note**: Limit to linear and exponential equations, and, in the case of exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs. **Essential Skills and Knowledge** • **Ability to distinguish between linear and exponential relationships given multiple representations** • **Ability to determine unknown parameters needed to create an equation that accurately models a given situation** A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. using Nemeth Braille Code. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* **(SC – Algebra I)** **Note**: Limit to linear equations and inequalities. **Essential Skills and Knowledge** • **Ability to distinguish between a mathematical solution and a contextual solution**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate toolsstrategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA I

Unit 1: Relationships between Quantities and Reasoning with Equations		
Cluster	**Standard**	**Practices**
	A.CED.4 Rearrange formulas in Nemeth Braille Code to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.* **Note**: Limit to formulas which are linear in the variable of interest. **Essential Skills and Knowledge** • **Ability to recognize/create equivalent forms of literal equations**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Understand solving equations as a process of reasoning and explain the reasoning.	A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a **viable argument** to justify a solution method. **Note**: Students should focus on and master A.REI.1 for linear equations and be able to extend and apply their reasoning to other types of equations in future courses. **Essential Skills and Knowledge** • **Ability to identify the mathematical property (addition property of equality, distributive property, etc.) used at each step in the solution process as a means of justifying a step**	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.**
Solve equations and inequalities in one variable.	A.REI.3 Solve linear equations and inequalities in **one** variable, including equations with coefficients represented by letters using Nemeth Braille Code. **Note**: Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for. Include simple exponential equations that rely only on application of the laws of exponents, such as $5^x=125$ or $2^x=1/16$. **Essential Skills and Knowledge** • **Ability to analyze the structure of an equation to determine the sequence of steps that need to be applied to arrive at a solution** • **Ability to accurately perform the steps needed to solve a linear equation/inequality** •	**Look for and make use of structure.** **Look for and express regularity in repeated reasoning..**

ALGEBRA I

Unit 2: Linear and Exponential Relationships

In earlier grades, students define, evaluate, and compare functions, and use them to model relationships between quantities. In this unit, students will learn function notation and develop the concepts of domain and range. They move beyond viewing functions as processes that take inputs and yield outputs and start viewing functions as objects in their own right. They explore many examples of functions, including sequences; they interpret functions given graphically, numerically, symbolically, and verbally, translate between representations, and understand the limitations of various representations. They work with functions given by graphs and tables, keeping in mind that, depending upon the context, these representations are likely to be approximate and incomplete. Their work includes functions that can be described or approximated by formulas as well as those that cannot. When functions describe relationships between quantities arising from a context, students reason with the units in which those quantities are measured. Students explore systems of equations and inequalities, and they find and interpret their solutions. Students build on and informally extend their understanding of integer exponents to consider exponential functions. They compare and contrast linear and exponential functions, distinguishing between additive and multiplicative change. They interpret arithmetic sequences as linear functions and geometric sequences as exponential functions.

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
Extend the properties of exponents to rational exponents.	N.RN.1 Explain how the definition of the meaning of rational exponents <u>in Nemeth Braille Code</u> follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want* $\left(5^{\frac{1}{3}}\right)^3 = 5^{\left(\frac{1}{3}\right)3}$ *to hold, so* $\left(5^{\frac{1}{3}}\right)^3$ *must equal 5.* **Note**: In implementing the standards in curriculum, this standard should occur before discussing exponential functions with continuous domains. **This means that students need understand that expressions such as $2^{\frac{1}{2}}, 2^{\frac{3}{4}}$, …have value before being introduced to an exponential function such as $y = 2^x$.** **Essential Skills and Knowledge** • **Ability to use prior knowledge of properties of integer exponents to build understanding of rational exponents and radicals** N.RN.2 Rewrite expressions involving radicals and rational exponents <u>in Nemeth Braille Code</u> using the properties of exponents . **Essential Skills and Knowledge** • **Knowledge of the connection between radical and exponential notation** • **Ability to translate between radical and exponential notation**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
Solve systems of equations.	A.REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions using Nemeth Braille Code **Note**: Build on student experiences with graphing and solving systems of linear equations from middle school to focus on justification of the methods used. Include cases where the two equations describe the same line (yielding infinitely many solutions) and cases where two equations describe parallel lines (yielding no solution); connect to **GPE.5** when it is taught in Geometry, which requires students to prove the slope criteria for parallel lines. **Essential Skills and Knowledge** • **Ability to use various methods for solving systems of equations algebraically** • **Ability to identify the mathematical property (addition property of equality, distributive property, etc.) used at each step in the solution process as a means of justifying a step** A.REI.6 Solve systems of linear equations exactly and approximately using Nemeth Braille Code (e.g., with tactile graphs), focusing on pairs of linear equations in two variables. **Essential Skills and Knowledge** • **Ability to extend experiences with solving simultaneous linear equations from 8EE.8 b&c to include more complex situations** • **Ability to solve systems using the most efficient method**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
Represent and solve equations and inequalities graphically.	A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line), using Nemeth Braille Code and tactile graphics. **Note**: Focus on linear and exponential equations and be able to adapt and apply that learning to other types of equations in future courses. **Essential Skills and Knowledge** • **Ability to construct an argument as to how the points that make up a curve connect to an algebraic representation of the function that is being represented by the graph** A.REI.11 Explain why the *x*-coordinates of the points where the graphs of the Nemeth Braille Code equations *y = f(x) and y = g(x)* intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using accessible technology (when it becomes available) to graph the functions, make tables of values in Nemeth Braille Code, or find **successive approximations.** Include cases where f(x) and/or g(x) are **linear**, polynomial, rational, absolute value, **exponential**, and logarithmic functions in Nemeth Braille Code. ★ **Note**: Focus on cases where f(x) and g(x) are linear or exponential. **Essential Skills and Knowledge** • **Ability to show the equality of two functions using multiple representations** A.REI.12 Graph the solutions to a linear inequality in two	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
	variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes using tactile drawing tools or a written description. **Essential Skills and Knowledge** • **Ability to explain why a particular shaded region represents the solution of a given linear inequality or system of linear inequalities** • **Ability to convey the mathematics behind the dotted versus solid boundary lines used when graphing the solutions to linear inequalities**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
Understand the concept of a function and use function notation.	F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y = f(x).* **Note**: Students should experience a variety of types of situations modeled by functions. Detailed analysis of any particular class of functions at this stage is not advised. Students should apply these concepts throughout their future mathematics courses. Draw examples from linear and exponential functions. **Essential Skills and Knowledge** • **Ability to determine if a relation is a function** • **Ability to identify the domain and range of a function from multiple representations** • **Ability to use of function notation** • **Knowledge of and ability to apply the vertical line test**	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
	F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to make connections between context and algebraic representations which use function notation** F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the* **Fibonacci sequence** *is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.* **Note**: Draw connection to **F.BF.2**, which requires students to write arithmetic and geometric sequences. Emphasize arithmetic and geometric sequences as examples of linear and exponential functions. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.**
Interpret functions that arise in applications in terms of a context.	F.IF.4 For a function that models a relationship between two quantities, interpret key features of the tactile graph and the table in Nemeth Braille Code in terms of the quantities, and sketch the graph using tactile drawing tools or a written description showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* ★ **Note**: Focus on linear and exponential functions. **Essential Skills and Knowledge** • **Ability to translate from algebraic representations to graphic or numeric representations and identify key features using the various representations**	**Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
	F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes using tactile graphics and Nemeth Braille Code. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* ★ **Note**: Focus on linear and exponential functions. **Note: This is an overarching standard that has applications in multiple units.** **Essential Skills and Knowledge** • **Ability to relate the concept of domain to each function studied** • **Ability to describe the restrictions on the domain of all functions based on real world context**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
	F.IF.6 Calculate and interpret the **average rate of change** of a function (presented symbolically or as a table) over a specified interval using Nemeth Braille Code. Estimate the rate of change from a tactile graph. ★ **Note**: Focus on linear functions and exponential functions whose domain is a subset of the integers. Unit 5 in this course and the Algebra II course address other types of functions. **Essential Skills and Knowledge** • **Knowledge that the rate of change of a function can be positive, negative or zero** • **Ability to identify the rate of change from multiple representations**	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
		reasoning.
Analyze functions using different representations.	**Cluster Note: For F.IF.7a, 7e, and 9 focus on linear and exponentials functions. Include comparisons of two functions presented algebraically. For example, compare the growth of two linear functions, or two exponential functions such as** $y = 3^n$ **and** $y = 100^n$ F.IF.7 Graph functions expressed symbolically in Nemeth Braille Code and show key features of the graph, by hand using tactile drawing tools or written description in simple cases and using accessible technology when it becomes available for more complicated cases. ★ Graph **linear** and quadratic functions and show **intercepts**, maxima, and minima. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** e. Graph **exponential** and logarithmic functions using tactile drawing tools or a written description, showing **intercepts and end behavior**, and trigonometric functions, showing period, midline, and amplitude. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** F.IF.9 Compare properties of two functions each represented in a different way (algebraically using Nemeth Braille Code, graphically in tactile graphics, numerically in Nemeth Braille Code tables, or by verbal descriptions). **Note: This is an overarching standard that will be visited again in Unit 5 Quadratic Functions and Modeling and in Algebra II** **Essential Skills and Knowledge** • **Ability to recognize common attributes of a**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
	function from various representations	**reasoning.**
Build a function that models a relationship between two quantities.	**Cluster Note: Limit F.BF.1a, 1b, and 2 to linear and exponential functions** F.BF.1 Write a function using Nemeth Braille Code that describes a relationship between two quantities. ★ a. Determine an explicit expression, a recursive process, or steps for calculation from a context. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** b. Combine standard function types using arithmetic operations and Nemeth Braille Code. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* **Essential Skills and Knowledge** • **Ability to add, subtract, multiply and divide functions** F.BF.2 Using Nemeth Braille Code, write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.★ **Note**: In F.BF.2, connect arithmetic sequences to linear functions and geometric sequences to exponential functions. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.**
Build new functions from existing functions.	F.BF.3 Identify the effect on the tactile graph of replacing *f(x)* by *f(x) + k, k f(x), f(kx),* and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the tactile graphs. Experiment with cases and illustrate an explanation of the effects on the graph using accessible	**Look for and make use of structure.** **Look for and express regularity in repeated**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
	technology when it becomes available. **Note**: Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept. While applying other transformations to a linear graph is appropriate at this level, it may be difficult for students to identify or distinguish between the effects of the other transformations included in this standard. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**reasoning.** **Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Construct and compare linear, quadratic, **and exponential models and solve problems.**	F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove using Nemeth Braille Code that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. **Essential Skills and Knowledge** • **Ability to recognize a linear relationship** c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. **Essential Skills and Knowledge** • **Ability to recognize an exponential relationship**	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated**

Unit 2: Linear and Exponential Relationships		
Cluster	**Standard**	**Practices**
	F.LE.2 Using tactile drawing tools or a written description, construct linear and exponential functions using Nemeth Braille Code including arithmetic and geometric sequences, given a tactile graph, a description of a relationship, or two input-output pairs (include reading these from a table). **Note**: In constructing linear functions draw on and consolidate previous work on finding equations for lines and linear functions **(8.EE.6, 8.F)**. **Essential Skills and Knowledge** • **Ability to produce an algebraic model** F.LE.3 Observe using tactile graphs and Nemeth Braille Code tables that a quantity increasing **exponentially** eventually exceeds a quantity increasing **linearly,** quadratically, or (more generally) as a polynomial function. **Note**: Limit to comparisons between linear and exponential models. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**reasoning.** **Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**
Interpret expressions for functions in terms of the situation they model.	F.LE.5 Interpret the **parameters** in a linear or exponential function in terms of a context using tactile graphics and Nemeth Braille Code. **Note**: Limit exponential functions to those of the form $f(x) = b^x + k$. **Essential Skills and Knowledge** • **Ability to interpret the slope and y-intercept of a linear model in terms of context** • **Ability to identify the initial amount present in an exponential model**	

ALGEBRA I

Unit 3: Descriptive Statistics

Experience with **descriptive statistics** began as early as Grade 6. Students were expected to display numerical data and summarize it using measures of center and variability. By the end of middle school they were creating scatter plots and recognizing linear trends in data. This unit builds upon that prior experience, providing students with more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

Unit 3: Descriptive Statistics		
Cluster	**Standard**	**Practices**
Summarize, represent, and interpret data on a *single* count or measurement variable.	**Cluster Note: In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.** S.ID.1 Represent data with plots on the real number line using tactile graphics and Nemeth Braille Code (dot plots, histograms, and box plots). **Essential Skills and Knowledge** • **Ability to determine the best data representation to use for a given situation** • **Knowledge of key features of each plot** • **Ability to correctly display given data in an appropriate plot** • **Ability to analyze data given in different formats**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 3: Descriptive Statistics		
Cluster	**Standard**	**Practices**
Summarize, represent, and interpret data on a *single* count or measurement variable.	S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets using tactile graphics and Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to interpret measures of center and spread (variability) as they relate to several data sets** • **Ability to identify shapes of distributions (skewed left or right, bell, uniform, symmetric)** • **Ability to recognize appropriateness of mean/standard deviation for symmetric data; 5 number summary for skewed data** S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers) using tactile graphics and Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to recognize gaps, clusters, and trends in the data set** • **Ability to recognize extreme data points(outliers) and their impact on center** • **Ability to effectively communicate what the data reveals** • **Knowledge that when comparing distributions there must be common scales and units**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to decision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 3: Descriptive Statistics		
Cluster	**Standard**	**Practices**
Summarize, represent, and interpret data on two categorical and quantitative variables.	S.ID.5 Summarize **categorical data** for two categories in two-way frequency tables using Nemeth Braille Code and tactile graphics. Interpret **relative frequencies** in the context of the data (including **joint, marginal, and conditional relative frequencies**). Recognize possible associations and trends in the data. **Essential Skills and Knowledge** • **Knowledge of the characteristics of categorical data** • **Ability to read and use a two-way frequency table** • **Ability to use and to compute joint, marginal, and conditional relative frequencies** • **Ability to read a segmented bar graph**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 3: Descriptive Statistics		
Cluster	**Standard**	**Practices**
Summarize, represent, and interpret data on *two* categorical and quantitative variables.	S.ID.6 represent data on two quantitative variables on a tactile graphic of a scatter-plot, and describe how the variables are related. a. Using tactile drawing tools, fit a function to the data; use functions in Nemeth Braille Code fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.* **Note**: S.ID.6.a.b. & c Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals. **Essential Skills and Knowledge** • **Ability to recognize types of relationships that lend themselves to linear and exponential models** • **Ability to create and use regression models to represent a contextual situation** b. Informally assess the fit of a function by plotting and analyzing **residuals,** using tactile drawing tools and Nemeth Braille Code symbols for caret and sigma. **Note**: Focus on linear models, but may use this standard to preview quadratic functions in Unit 5 of this course **Essential Skills and Knowledge** • **Ability to create a graphic display of residuals** • **Ability to recognize patterns in residual plots** • **Ability to calculate error margins (residuals) with a calculator**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 3: Descriptive Statistics		
Cluster	**Standard**	**Practices**
	Using tactile drawing tools or Nemeth Braille Code, fit a linear function for a tactile graphic of a scatter plot that suggests a linear association **Essential Skills and Knowledge** • **Ability to recognize a linear relationship displayed in a scatter plot** • **Ability to determine an equation for the line of best fit for a set of data points**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Interpret linear models.	S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a tactile graphic of a linear model in the context of the data, using Nemeth Braille Code. **(SC-Algebra I)** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** S.ID.8 Compute (using accessible technology when it becomes available) and interpret the **correlation coefficient** of a linear fit. **Notes**: Build on student experience with linear relationships in eighth grade and introduce the **correlation coefficient**. The focus here is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and a cause-and-effect relationship arises in S.ID.9. **Essential Skills and Knowledge** • **Knowledge of the range of the values ($-1 \le r \le 1$)and the interpretation of those values for correlation coefficients** • **Ability to compute and analyze the correlation coefficient for the purpose of communicating the goodness of fit of a linear model for a given data set**	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 3: Descriptive Statistics		
Cluster	**Standard**	**Practices**
	S.ID.9 Distinguish between **correlation** and **causation**. **Essential Skills and Knowledge** • **Ability to provide examples of two variables that have a strong correlation but one does not cause the other**	

ALGEBRA I

Unit 4: Expressions and Equations

In this unit, students build on their knowledge from unit 2, where they extended the laws of exponents to rational exponents. Students apply this new understanding of number and strengthen their ability to see structure in and create quadratic and exponential expressions. They create and solve equations, inequalities, and systems of equations involving quadratic expressions.

Unit 4: Expressions and Equations		
Cluster	**Standard**	**Practices**
Interpret the structure of expressions.	**Cluster Note: Focus on quadratic and exponential expressions.** A.SSE.1 Interpret expressions in Nemeth Braille Code that represent a quantity in terms of its context. ★ a. Interpret parts of an expression, in Nemeth Braille Code, such as terms, factors, and coefficients. **Essential Skills and Knowledge** • **Ability to extend knowledge of A.SSE.1b from Unit 1 of this course to include quadratic and exponential expressions** b. Interpret complicated expressions in Nemeth Braille Code by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.* **Note**: Exponents are extended from the integer exponents found in Unit 1 to rational exponents focusing on those that represent square or cube roots. **Essential Skills and Knowledge** • **Ability to extend knowledge of A.SSE.1b from Unit 1 of this course to quadratic and exponential expressions** A.SSE.2 Use the structure of an expression in Nemeth Braille Code to identify ways to rewrite it. *For example, see* $4x^2-9y^2$ as $2x^2-3y^2$, *thus recognizing it as a difference of squares that can be factored as* $2x-3y \quad 2x+3y$	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 4: Expressions and Equations		
Cluster	**Standard**	**Practices**
	Note: This is an overarching standard that has applications in multiple units. **Essential Skills and Knowledge** • **Ability to use properties of mathematics to alter the structure of an expression** • **Ability to select and then use an appropriate factoring technique**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
Write expressions in equivalent forms to solve problems.	**Cluster Note: It is important to balance conceptual understanding and procedural fluency in work with equivalent expressions. For example, development of skill in factoring and completing the square goes hand-in-hand with understanding what different forms of a quadratic expression reveal**. A.SSE.3 Choose and produce an equivalent form of an expression in Nemeth Braille Code to reveal and explain properties of the quantity represented by the expression. ★ a. Factor a quadratic expression in Nemeth Braille Code to reveal the zeros of the function it defines. **Essential Skills and Knowledge** • **Ability to connect the factors, zeros and *x*-intercepts of a graph** • **Ability to use the Zero-Product Property to solve quadratic equations** • **Ability to recognize that quadratics that are perfect squares produce graphs which are tangent to the x-axis at the vertex**	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure. and express regularity in repeated reasoning.**

Unit 4: Expressions and Equations		
Cluster	**Standard**	**Practices**
	b. Complete the square in a quadratic expression in Nemeth Braille Code to reveal the maximum or minimum value of the function it defines. **Essential Skills and Knowledge** • **Ability to recognize key features of a quadratic model given in vertex form** c. Use the properties of exponents to transform expressions for exponential functions in Nemeth Braille Code. *For example the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.01212t$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* **Essential Skills and Knowledge** • **Ability to connect experience with properties of exponents from Unit 2 of this course to more complex expressions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.**
Perform arithmetic operations on polynomials.	A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are **closed** under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials using Nemeth Braille Code. **Note: Limit to linear and quadratic polynomials** **Essential Skills and Knowledge** • **Ability to show that when polynomials are added, subtracted or multiplied that the result is another polynomial**	**Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 4: Expressions and Equations		
Cluster	**Standard**	**Practices**
Create equations that describe numbers or relationships.	**Cluster Note: Extend work on linear and exponential equations in Unit 1 to quadratic equations.** A.CED.1 Using Nemeth Braille Code, create equations and inequalities in **one** variable and use them to solve problems. *Include equations arising from linear and* ***quadratic*** *functions, and simple rational and exponential functions.* **Essential Skills and Knowledge** • **Ability to distinguish between linear, quadratic and exponential relationships given the verbal, numeric and/or graphic representations** A.CED.2 Using Nemeth Braille Code, create equations in two or more variables to represent relationships between quantities; using tactile drawing tools, graph equations on tactile coordinate axes with Nemeth Braille Code labels and scales. **Essential Skills and Knowledge** • **Ability to distinguish between linear, quadratic and exponential relationships given numeric, or verbal representations** • **Ability to determine unknown parameters needed to create an equation that accurately models a given situation** A.CED.4 Rearrange formulas in Nemeth Braille Code to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.* **Note**: Extend to formulas involving squared variables **Essential Skills and Knowledge** • **Ability to recognize and create different forms of literal equations**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 4: Expressions and Equations		
Cluster	**Standard**	**Practices**
Solve equations and inequalities in one variable.	**Cluster Note: Students should learn of the existence of the complex number system, but will not solve quadratics with complex solutions until Algebra II.** A.REI.4 Solve quadratic equations in one variable in Nemeth Braille Code. a. Using Nemeth Braille Code, use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. **Essential Skills and Knowledge** • **Ability to solve literal equations for a variable of interest** b. Solve quadratic equations in Nemeth Braille Code by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the **quadratic formula reveals that the quadratic equation has "no real solutions".** **Essential Skills and Knowledge** • **Ability to solve quadratic equations using various methods and recognize the most efficient method** • **Ability to use the value of the discriminant to determine if a quadratic equation has one double solution, two unique solutions or no real solutions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 4: Expressions and Equations		
Cluster	**Standard**	**Practices**
Solve systems of equations.	A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically <u>using Nemeth Braille Code</u> and graphically <u>using tactile graphics and drawing tools</u>. *For example, find the points of intersection between the line y = –3x and the circle $x^2 + y^2 = 3$.* **Note**: Include systems consisting of one linear and one quadratic equation. Include systems that lead to work with fractions. For example, finding the intersections between $x^2 + y^2 = 1$ and $y = \frac{x+1}{2}$ leads to the point $\left(\frac{3}{4}, \frac{4}{5}\right)$ on the unit circle, corresponding to the Pythagorean triple $3^2+4^2=5^2$. **Essential Skills and Knowledge** • **Knowledge of the algebraic and graphic representations of quadratic relations as well as quadratic functions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA I

Unit 5: Quadratic Functions and Modeling

In preparation for work with quadratic relationships students explore distinctions between rational and irrational numbers. They consider quadratic functions, comparing the key characteristics of quadratic functions to those of linear and exponential functions. They select from among these functions to model phenomena. Students learn to anticipate the graph of a quadratic function by interpreting various forms of quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function. Students learn that when quadratic equations do not have real solutions the number system must be extended so that solutions exist, analogous to the way in which extending the whole numbers to the negative numbers allows x+1 = 0 to have a solution. Formal work with complex numbers comes in Algebra II. Students expand their experience with functions to include more specialized functions—absolute value, step, and those that are piecewise-defined.

Unit 5: Quadratic Functions and Modeling		
Cluster	**Standard**	**Practices**
Use properties of rational and irrational numbers.	N.RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. **Note**: Connect to physical situations, *e.g., finding the perimeter of a square of area 2.* **Essential Skills and Knowledge** • **Ability to perform operations on both rational and irrational numbers**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 5: Quadratic Functions and Modeling		
Cluster	**Standard**	**Practices**
Interpret functions that arise in applications in terms of a context.	**Cluster Note: Focus on quadratic functions; compare with linear and exponential functions studied in Unit 2** **Note: These are overarching standards that will be revisited for each function studied but as each new function is introduced, modeling problems should not be limited to just the newly introduced function but should include all functions studied.** F.IF.4 For a function that models a relationship between two quantities, interpret key features of tactile graphs and Nemeth Braille Code tables in terms of the quantities, and sketch graphs using tactile drawing tools or written descriptions showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* ★ **Essential Skills and Knowledge** • **Ability to connect experiences with linear and exponential functions from Unit 2 of this course to quadratic models** • **Ability to connect appropriate function to context** F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* ★ **Essential Skills and Knowledge** • **Ability to connect experiences with linear and exponential functions from Unit 2 of this course to quadratic models**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 5: Quadratic Functions and Modeling		
Cluster	**Standard**	**Practices**
	• **Ability to describe the restrictions on the domain of a function based on real world context** • **Ability to recognize and use alternate vocabulary for domain and range such as input/output or independent/dependent** F.IF.6 Calculate and interpret the **average rate of change** of a function in Nemeth Braille Code (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a tactile graph. ★ **Essential Skills and Knowledge** • **Knowledge that the rate of change of a function can be positive, negative or zero** • **Ability to identify the rate of change from multiple representations**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 5: Quadratic Functions and Modeling		
Cluster	**Standard**	**Practices**
Analyze functions using different representations.	**Cluster Note: This unit, and in particular in F.IF.8b, extends the work begun in Unit 2 on exponential functions with integer exponents. Extend work with quadratics to include the relationship between coefficients and roots, and that once roots are known, a quadratic equation can be factored.** F.IF.7 Graph functions expressed symbolically in Nemeth Braille Code and show key features of the graph, by hand in simple cases using tactile graphs and drawing tools or written description and using accessible technology when it becomes available for more complicated cases. ★ a. Graph linear and **quadratic** functions and show intercepts, **maxima, and minima** using tactile graphics and drawing tools or written description. **Essential Skills and Knowledge** • **Ability to connect experience with graphing linear functions from Unit 2 of this course to include quadratic functions** b. Graph square root, cube root, and **piecewise-defined** functions, including **step** functions and **absolute value** functions using tactile graphics and drawing tools or written description. **Note**: Compare and contrast absolute value, step and piecewise defined functions with linear, quadratic, and exponential functions. Highlight issues of domain, range, and usefulness when examining piecewise-defined functions **Essential Skills and Knowledge** • **Ability to make a quick sketch of each parent function over the set of real numbers** • **Ability to make connections between a function's**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 5: Quadratic Functions and Modeling		
Cluster	**Standard**	**Practices**
Analyze functions using different representations.	**domain and range and the appearance of the graph of the function** • **Knowledge of how parameters introduced into a function alter the shape of the graph of the parent function** F.IF.8 Write a function defined by an expression using Nemeth Braille Code in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context using Nemeth Braille Code and tactile graphics. **Essential Skills and Knowledge** • **Ability to make connections between different algebraic representations, a graph and a contextual model** b. Use the properties of exponents to interpret expressions for exponential functions using Nemeth Braille Code. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.* **Essential Skills and Knowledge** • **Ability to connect experience with properties of exponents from Unit 2 Linear and Exponential Relationships of this course to more complex expressions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 5: Quadratic Functions and Modeling		
Cluster	**Standard**	**Practices**
	F.IF.9 Compare properties of two functions each represented in a different way (algebraically using Nemeth Braille Code, graphically using tactile graphics, numerically in tables using Nemeth Braille Code, or by verbal descriptions **Note**: Focus on expanding the types of functions considered to include, linear, exponential, and **quadratic**. **Essential Skills and Knowledge** • **Ability to connect experience with comparing linear and exponential functions from Unit 2 of this course to include quadratic functions** • **Ability to recognize common attributes of a function from multiple representations**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.**
Build a function that models a relationship between two quantities.	**Cluster Note: Focus on situations that exhibit a quadratic relationship.** F.BF.1 Write a function using Nemeth Braille Code that describes a relationship between two quantities. ★ a. Using Nemeth Braille Code, determine an explicit expression, a recursive process, or steps for calculation from a context. **Essential Skills and Knowledge** • **Ability to connect experience with linear and exponential functions from Unit 2 of this course to quadratic functions** • **Ability to write the algebraic representation of a quadratic function from a contextual situation**	**Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 5: Quadratic Functions and Modeling		
Cluster	**Standard**	**Practices**
	b. Combine standard function types using arithmetic operations using Nemeth Braille Code. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* **Essential Skills and Knowledge** • **Ability to connect experience with linear and exponential functions from Unit 2 of this course to quadratic functions** • **Ability to add, subtract, multiply and divide functions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
Build new functions from existing functions.	F.BF.3 Identify the effect on the tactile graph of replacing *f(x)* by *f(x) + k, k f(x), f(kx)*, and *f(x + k)* for specific values of *k* (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using accessible technology when it becomes available. **Note**: Focus on quadratic functions, and consider including absolute value functions. **Note: This is an overarching standard that has applications in multiple units in this course.** **Essential Skills and Knowledge** • **Ability to make generalizations about the changes that will result in the graph of any function as a result of making a particular change to the algebraic representation of the function**	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 5: Quadratic Functions and Modeling		
Cluster	**Standard**	**Practices**
	F.BF.4 Find inverse functions. a. Solve an equation of the form *f(x) = c* for a simple function *f* that has an inverse and write an expression for the inverse using Nemeth Braille Code. **Note**: Focus on linear functions but consider simple situations where the domain of the function must be restricted in order for the inverse to exist, such as $f(x) = x^2$, $x>0$. **Essential Skills and Knowledge** • **Ability to determine if the inverse of a function is also a function** • **Ability to restrict the domain of a function in a way that will allow the inverse to represent a function** • **Knowledge of the connection between the domain and range of a function and its inverse**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
Construct and compare linear, quadratic, and exponential models and solve problems.	F.LE.3 Observe using tactile graphs and Nemeth Braille Code tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. **Note**: Compare linear and exponential growth to quadratic growth **Note: This is an overarching standard that has applications in multiple units in this course.** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships

This unit develops the structural similarities between the system of polynomials and the system of integers. Students draw on analogies between polynomial arithmetic and base-ten computation, focusing on properties of operations, particularly the distributive property. Students connect multiplication of polynomials with multiplication of multi-digit integers, and division of polynomials with long division of integers. Students identify zeros of polynomials, including complex zeros of quadratic polynomials, and make connections between zeros of polynomials and solutions of polynomial equations. The unit culminates with the fundamental theorem of algebra. Rational numbers extend the arithmetic of integers by allowing division by all numbers except 0. Similarly, rational expressions extend the arithmetic of polynomials by allowing division by all polynomials except the zero polynomial. A central theme of this unit is that the arithmetic of rational expressions is governed by the same rules as the arithmetic of rational numbers.

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships		
Cluster	**Standard**	**Practices**
Perform arithmetic operations with complex numbers.	N.CN.1 Know there is a complex number *i* such that $i^2 = -1$, and every complex number has the form *a + bi* with *a* and *b* real. **Essential Skills and Knowledge** • **Ability to extend experience with solving quadratic equations with no real solution from Algebra I to the existence of complex numbers (e.g. use solving $x^2+1=0$ as a way to introduce complex numbers)** N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers <u>using Nemeth Braille Code</u>. **Essential Skills and Knowledge** • **Knowledge of conjugate pairs and the nature of their products**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
Use complex numbers in polynomial identities and equations.	N.CN.7 Solve quadratic equations <u>using Nemeth Braille Code</u> with real coefficients that have complex solutions. **Note**: Limit to polynomials with real coefficients. **Essential Skills and Knowledge** • **Ability to use the quadratic formula and/or completing the square as a means of solving a quadratic equation** • **Knowledge that complex solutions occur in conjugate pairs** • **Ability to connect experience with solving quadratic equations from Algebra I to situations where analyzing the discriminant will reveal the nature of the solutions which would include complex solutions** N.CN.8 (+)<u>Using Nemeth Braille Code</u>, extend **polynomial identities** to the complex numbers. *For example, rewrite* x^2+4 as $x^2-(-4)=x^2-\ -2i\ ^2=\ x-\ -2i\quad x+\ -2i\ =\ x+2i\quad x-2i$ **Essential Skills and Knowledge** • **Knowledge that a negative number can be thought of as the square of an imaginary number** e.g. $-4=\ -2i\ ^2$	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships		
Cluster	**Standard**	**Practices**
	N.CN.9 (+) Know the **Fundamental Theorem of Algebra**; show, using Nemeth Braille Code that it is true for quadratic polynomials. **Essential Skills and Knowledge** • **Knowledge of the connection between the number of roots and the degree of the polynomial; considering multiple roots, complex roots and distinct real roots**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Interpret the structure of expressions.	**Cluster Note: Extend to polynomial and rational expressions.** A.SSE.1 Interpret expressions in Nemeth Braille Code that represent a quantity in terms of its context. ★ a. Interpret parts of an expression in Nemeth Braille Code, such as terms, factors, and coefficients. **Essential Skills and Knowledge** • **Ability to connect experience in Algebra I with vocabulary that explicitly identifies coefficients, terms, and extend to degree, powers (positive and negative), leading coefficients, monomial… to more complicated expressions such as polynomial and rational expressions** • **Ability to use appropriate vocabulary to categorize polynomials and rational expressions** b. Interpret complicated expressions using Nemeth Braille Code by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.* **Note: This is an overarching standard that has applications in multiple units and multiple courses.** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools and strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships		
Cluster	**Standard**	**Practices**
	A.SSE.2 Using Nemeth Braille Code, use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.* **Note: This is an overarching standard that has applications in multiple units and multiple courses.** **Essential Skills and Knowledge** • **Ability to use properties of mathematics to alter the structure of an expression** • **Ability to select and then use an appropriate factoring technique** • **Ability to factor expressions completely over complex numbers**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
Write expressions in equivalent forms to solve problems.	A.SSE.4 Using Nemeth Braille Code, derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.* ★ **Note**: Consider extending this standard to infinite geometric series in curricular implementations of this course description. **Essential Skills and Knowledge** • **Knowledge of the difference between an infinite and a finite series** • **Ability to apply the formula for the sum of a finite geometric series :** $S_n = \frac{a\ 1-r^n}{1-r}$	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships		
Cluster	**Standard**	**Practices**
Perform arithmetic operations on polynomials.	A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are **closed** under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials using Nemeth Braille Code. **Note: Extend to polynomials beyond quadratics** **Essential Skills and Knowledge** • **Ability to connect experiences from Algebra I with linear and quadratic polynomials to polynomials of higher degree** • **Ability to show that when polynomials are added, subtracted or multiplied that the result is another polynomial**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.**
Understand the relationship between **zeros and factors of polynomials.**	A.APR.2 Know and apply the **Remainder Theorem** using Nemeth Braille Code : For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$. **Essential Skills and Knowledge** • **Ability to make connections between factors, roots and evaluating functions** • **Ability to use both long division and synthetic division** • **Ability to use the graph of a polynomial to assist in the efficiency of the process for complicated cases**	**Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships		
Cluster	**Standard**	**Practices**
	A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct, using tactile graphics, and tactile drawing tools or a written description, a rough graph of the function defined by the polynomial. **Essential Skills and Knowledge** • **Knowledge of the differences in the end behavior of the graphs as dictated by the leading coefficient and whether the function is even or odd** • **Ability to capture the graphical behavior of polynomial functions which have roots with multiplicity greater than one**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
Use polynomial identities to solve problems.	**Cluster Note: This cluster has many possibilities for optional enrichment, such as relating the example in A.APR.4 to the solution of the system $u^2+v^2=1$, $v = t(u+1)$, relating the Pascal triangle property of binomial coefficients to $(x+y)^{n+1} = (x+y)(x+y)^n$, deriving explicit formulas for the coefficients, or proving the binomial theorem by induction.** A.APR.4 Using Nemeth Braille Code, prove **polynomial identities** and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples. **Essential Skills and Knowledge** • **Knowledge of the process for proving identities** • **Ability to see, use and manipulate the structure in an expression as needed to prove an identity**	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships		
Cluster	**Standard**	**Practices**
	A.APR.5 (+) Know and apply, using Nemeth Braille Code and symbols for summation and factorials, the **Binomial Theorem** for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by a tactile graphic of Pascal's Triangle. **Note**: The **Binomial Theorem** can be proved by **mathematical induction** or by combinatorial argument. **Essential Skills and Knowledge** • **Ability to replicate Pascal's triangle**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Rewrite rational expressions	A.APR.6 Rewrite simple rational expressions in different forms using Nemeth Braille Code; write $\frac{a(x)}{b(x)}$ in the form $q(x)+\frac{r(x)}{b(x)}$ where $a(x), b(x), q(x)$ and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, an accessible computer algebra system when it becomes available. **Note**: The limitations on rational functions apply to the rational expressions in this standard. *Limitations: In this course rational functions are limited to those whose numerators are of degree at most one and denominators of degree at most 2.* **Essential Skills and Knowledge** • **Ability to make connections to the Remainder Theorem** A.APR.7 (+) Understand that rational expressions form a system analogous to the rational numbers, **closed** under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions using Nemeth Braille Code. **Note**: A.APR.7 requires the **general division algorithm** for polynomials. **Essential Skills and Knowledge** • **Ability to make connections between the algorithms for operations on rational numbers and operations on rational expressions**	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships		
Cluster	**Standard**	**Practices**
Understand solving equations as a process of reasoning and explain the reasoning.	A.REI.2 Using Nemeth Braille Code, solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. **Essential Skills and Knowledge** • **Ability to connect prior experience with solving simple equations in one variable to solving equations which require new strategies and additional steps** • **Ability to make connections between the domain of a function and extraneous solutions** • **Ability to identify extraneous solutions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.**
Represent and solve equations and inequalities graphically.	A.REI.11 Explain why the *x*-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect on a tactile graphic are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using accessible technology when it becomes available to graph the functions, make tables of values using Nemeth Braille Code and accessible technology, or find **successive approximations** using accessible technology. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. ★ **Note**: Include combinations of linear, polynomial, rational, radical, absolute value, and exponential functions. **Note: This is an overarching standard that will be revisited as each function is studied.** **Essential Skills and Knowledge** • **Ability to connect experience with solving systems of equations graphically from Algebra I to solving systems that include polynomial, exponential ,rational, root , absolute value and logarithmic functions** • **Ability to show the equality of two functions using multiple representations**	**Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 1: Polynomial, Rational, and Radical Relationships		
Cluster	**Standard**	**Practices**
Analyze functions using different representations.	F.IF.7 Graph functions expressed symbolically using Nemeth Braille Code and show key features of the graph, by hand in simple cases using tactile drawing tools or written descriptions and using accessible technology when it becomes available for more complicated cases. ★ c. Using tactile drawing tools, graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. **Note**: Relate this standard to the relationship between zeros of quadratic functions and their factored forms. **Essential Skills and Knowledge** • **Ability to connect experience with graphing linear, exponential and quadratic functions from Algebra I to graphing polynomial functions** • **Ability to identify key features of a function: max, min, intercepts, zeros, and end behaviors.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 2: Trigonometric Functions

Building on their previous work with functions, and on their work with trigonometric ratios and circles in Geometry, students now use the coordinate plane to extend trigonometry to model periodic phenomena.

Unit 2: Trigonometric Functions		
Cluster	**Standard**	**Practices**
Extend the domain of trigonometric functions using the unit circle.	F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. **Essential Skills and Knowledge** • **Knowledge that angle measures in radians may be determined by a ratio of intercepted arc to radius** • **Ability to convert between degree and radian measure** F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle. **Essential Skills and Knowledge** • **Ability to connect knowledge of special right triangles gained in Geometry to evaluating trigonometric functions at any domain value** • **Ability to extend to angles beyond [-2π, 2π], using counterclockwise as the positive direction of rotation**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 2: Trigonometric Functions		
Cluster	**Standard**	**Practices**
Model periodic phenomena with trigonometric functions.	F.TF.5 Choose trigonometric functions in Nemeth Braille Code to model periodic phenomena with specified amplitude, frequency, and midline. ★ **Essential Skills and Knowledge** • **Ability to connect contextual situations to appropriate trigonometric function: e.g. using sine or cosine to model cyclical behavior**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Prove and apply trigonometric identities.	F.TF.8 Using Nemeth Braille Code, prove the **Pythagorean identity** $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find sin (θ), cos (θ), or tan (θ), given sin (θ), cos (θ), or tan (θ), and the quadrant of the angle. **Essential Skills and Knowledge** • **Ability to make connections to angles in standard position** **Note**: An Algebra II course with an additional focus on trigonometry could include the (+) standard F.TF.9: Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems. This could be limited to acute angles in Algebra II.	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 3: Modeling with Functions

In this unit students synthesize and generalize what they have learned about a variety of function families. They extend their work with exponential functions to include solving exponential equations with logarithms. They explore the effects of transformations on graphs of diverse functions, including functions arising in an application, in order to abstract the general principle that transformations on a graph always have the same effect regardless of the type of the underlying function. They identify appropriate types of functions to model a situation, they adjust parameters to improve the model, and they compare models by analyzing appropriateness of fit and making judgments about the domain over which a model is a good fit. *The description of modeling as "the process of choosing and using mathematics and statistics to analyze empirical situations, to understand them better, and to make decisions" is at the heart of this unit. The narrative discussion and diagram of the modeling cycle should be considered when knowledge of functions, statistics, and geometry is applied in a modeling context.*

Unit 3: Modeling with Functions		
Cluster	**Standard**	**Practices**
Create equations that describe numbers or relationships.	**Cluster Note: For A.CED.1, use all available types of functions to create such equations, including root functions, but constrain to simple cases. While functions used in A.CED.2, 3, and 4 will often be linear, exponential, or quadratic the types of problems should draw from more complex situations than those addressed in Algebra I. For example, finding the equation of a line through a given point perpendicular to another line allows one to find the distance from a point to a line.** *Limitations: In this course rational functions are limited to those whose numerators are of degree at most one and denominators of degree at most 2.* A.CED.1 Using Nemeth Braille Code, create equations and inequalities in **one** variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and **simple rational** and exponential functions.* **Essential Skills and Knowledge** • **Ability to connect experience from Algebra I with creating linear, exponential and quadratic equations in one variable to include creating simple rational functions** • **Ability to distinguish between linear, quadratic, exponential, root and simple rational relationships given the verbal, numeric and/or graphic representations** A.CED.2 Using Nemeth Braille Code, create equations in **two or more** variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales using tactile drawing tools and Nemeth Braille Code.**Note: These are overarching standards that will be revisited for each function studied but as each new function is introduced, modeling problems should not be**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 3: Modeling with Functions		
Cluster	**Standard**	**Practices**
Create equations that describe numbers or relationships.	**limited to just the newly introduced function but should include all functions studied to date including those studied in Algebra I.** **Essential Skills and Knowledge** • **Ability to distinguish between linear, quadratic exponential and simple rational relationships given multiple representations** • **Ability to determine unknown parameters needed to create an equation that accurately models a given situation** • **Ability to produce the graph of a function, that is being used to model relationships, which would include appropriate scales and labels as to accurate display all aspects of the relation** A.CED.3 Using Nemeth Braille Code, represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* **Essential Skills and Knowledge** • **Ability to distinguish between a mathematical solution and a contextual solution** A.CED.4 Rearrange formulas in Nemeth Braille Code to highlight a **quantity of interest**, using the same reasoning as in solving equations. **Essential Skills and Knowledge** • **Ability to connect experience with rearranging formulas that were linear in nature from Algebra I to manipulating formulas that are not linear in nature**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 3: Modeling with Functions		
Cluster	**Standard**	**Practices**
Interpret functions that arise in applications in terms of a context.	**Cluster Note: Emphasize the selection of a model function based on behavior of data and context.** **Note: These are overarching standards that will be revisited for each function studied but as each new function is introduced, modeling problems should not be limited to just the newly introduced function but should include all functions studied to date including those studied in Algebra I.** F.IF.4 For a function that models a relationship between two quantities, interpret key features of tactile graphs and Nemeth Braille Code tables in terms of the quantities, and sketch graphs showing key features using tactile drawing tools or written descriptions, given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* ★ **Essential Skills and Knowledge** • **Ability to connect appropriate function to context** • **Knowledge of the key features of linear, exponential, polynomial, root, absolute value, piece-wise, simple rational, logarithmic and trigonometric functions** F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* ★ **Essential Skills and Knowledge** • **Ability to relate the concept of domain to each function studied** • **Ability to describe the restrictions on the domain of all functions studied based on real world context**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 3: Modeling with Functions		
Cluster	**Standard**	**Practices**
Interpret functions that arise in applications in terms of a context	F.IF.6 Using Nemeth Braille Code, calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a tactile graph. ★ **Essential Skills and Knowledge** • **Ability to apply this skill to linear, quadratic, polynomial, root and simple rational functions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

Unit 3: Modeling with Functions		
Cluster	**Standard**	**Practices**
Analyze functions using different representations.	**Cluster Note: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.** F.IF.7 Graph functions expressed symbolically in Nemeth Braille Code and show key features of the graph, by hand in simple cases using tactile drawing tools and written descriptions and using accessible technology when it becomes available for more complicated cases. ★ b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions using tactile graphics and drawing tools or written description.. **Essential Skills and Knowledge** • **Ability to connect experience with graphing linear and quadratic functions from Algebra I to graphing square root, cube root and a variety of piece-wise defined functions** • **Ability to produce a rough graph of the parent function for each type of function** • **Knowledge of how parameters introduced into a function alter the shape of the graph of the parent function** e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude using tactile drawing tools or a written description. **Essential Skills and Knowledge** • **Ability to connect experience with graphing linear and quadratic functions from Algebra I to graphing exponential and logarithmic functions** • **Ability to produce a rough graph of the parent function for each type of function** • **Knowledge of how parameters introduced into a function alter the shape of the graph of the parent function**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 3: Modeling with Functions		
Cluster	**Standard**	**Practices**
Analyze functions using different representations.	F.8 Using Nemeth Braille Code, write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **Essential Skills and Knowledge** • **Ability to connect experience with writing linear, quadratic and exponential functions in various forms from Algebra I to writing all functions in various forms** • **Ability to recognize functions in various forms** F.IF.9 Compare properties of two functions each represented in a different way (algebraically using Nemeth Braille Code, graphically using tactile graphics, numerically in tables using Nemeth Braille Code,, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.* **Essential Skills and Knowledge** • **Ability to recognize common attributes of functions from various representations**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** .
Build a function that models a relationship between two quantities.	F.BF.1 Write a function that describes a relationship between two quantities using Nemeth Braille Code. ★ b. Combine standard function types using arithmetic operations in Nemeth Braille Code. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* **Note**: Develop models for more complex or sophisticated situations than in previous courses.	**Look for and express regularity in repeated reasoning**

ALGEBRA II

Unit 3: Modeling with Functions		
Cluster	**Standard**	**Practices**
	Essential Skills and Knowledge • **Ability to connect experience with adding, subtracting , multiplying and dividing linear, quadratic and exponential functions from Algebra I to adding, subtracting, multiplying and dividing any functions** • **Ability to create a new function that is the composition of two or more functions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Build new functions from existing functions.	F.BF.3 Identify the effect on the graph of replacing *f(x)* by *f(x) + k, k f(x), f(kx),* and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using accessible technology when it becomes available. Include recognizing **even and odd functions** from their graphs and algebraic expressions for them. **Note**: Use transformations of functions to find models as students consider increasingly more complex situations. Note the effect of multiple transformations on a single graph and the common effect of each transformation across function types. **Essential Skills and Knowledge** • **Ability to connect experience with this standard as it relates to linear, quadratic and exponential functions from Algebra I to all functions studied** • **Ability to make generalizations about the changes that will take place in the graph of any function as a result of making a particular change to the algebraic representation of the function**	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 3: Modeling with Functions		
Cluster	**Standard**	**Practices**
	F.BF.4 Find inverse functions. a. Using Nemeth Braille Code, solve an equation of the form *f(x) = c* for a simple function *f* that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x^3$ or f(x) = (x+1)/(x-1) for x ≠ 1.* **Note**: Extend this standard to **simple rational**, simple radical, and simple exponential functions; connect this standard to F.LE.4. **i.e. use inverses to show the connection between exponential and logarithmic functions.** **Essential Skills and Knowledge** • **Ability to connect experience with finding the inverse of a linear function from Algebra I to finding the inverse of simple exponential, root and rational functions** • **Knowledge of the connection of the domain and range of a function to its inverse** • **Ability to determine if a function has an inverse**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.**
Construct and compare linear, quadratic, and exponential models and solve problems.	F.LE.4 For exponential models, express as a logarithm in Nemeth Braille Code, the solution to $a\,b^{ct} = d$ where *a, c*, and *d* are numbers and the base *b* is 2, 10, or *e*; evaluate the logarithm using accessible technology. **Note**: Consider extending this unit to include the relationship between properties of logarithms and properties of exponents, such as the connection between the properties of exponents and the basic logarithm property that log xy = log x +log y. **Essential Skills and Knowledge** • **Knowledge that logarithmic functions are inverses of exponential functions** • **Knowledge of the properties of logarithms and exponents and their connection to one another**	**Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 4: Inferences and Conclusions from Data

In this unit, students see how the visual displays and summary statistics they learned in earlier grades relate to different types of data and to probability distributions. They identify different ways of collecting data—including sample surveys, experiments, and simulations—and the role that randomness and careful design play in the conclusions that can be drawn.

Unit 4: Inferences and Conclusions from Data		
Cluster	**Standard**	**Practices**
Summarize, represent, and interpret data on a single count or measurement variable.	S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use accessible calculators, spreadsheets, and Nemeth Braille Code tables to estimate areas under the normal curve. **Note**: While students may have heard of the normal distribution, it is unlikely that they will have prior experience using it to make specific estimates. Build on students' understanding of data distributions to help them see how the normal distribution uses area to make estimates of frequencies (which can be expressed as probabilities). Emphasize that only some data are well described by a normal distribution. **Essential Skills and Knowledge** • **Ability to construct, interpret and use normal curves, based on standard deviation** • **Ability to identify data sets as approximately normal or not** • **Ability to estimate and interpret area under curves using the Empirical Rule (68-95-98.7%)**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 4: Inferences and Conclusions from Data		
Cluster	**Standard**	**Practices**
Understand and evaluate random processes underlying statistical experiments.	S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. **Essential Skills and Knowledge** • **Knowledge of various sampling methods (e.g., simple random, convenience , stratified…)** • **Ability to select an appropriate sampling technique for a given situation** • **Ability to explain in context the difference between values describing a population and a sample** S.IC.2 Decide if a specified model is consistent with results from a given **data-generating process**, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?* **Note**: Include comparing theoretical and empirical results to evaluate the effectiveness of a treatment. **Essential Skills and Knowledge** • **Ability to calculate and analyze theoretical and experimental probabilities accurately** • **Knowledge of various types of sampling procedures and ability to select and carry out the appropriate process for a given situation** • **Ability to design, conduct and interpret the results of simulations** • **Ability to explain and use the Law of Large Numbers**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 4: Inferences and Conclusions from Data		
Cluster	**Standard**	**Practices**
Make inferences and justify conclusions from sample surveys, experiments, and observational studies.	S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. **Note**: In earlier grades, students are introduced to different ways of collecting data and use graphical displays and summary statistics to make comparisons. These ideas are revisited with a focus on how the way in which data is collected determines the scope and nature of the conclusions that can be drawn from that data. The concept of statistical significance is developed informally through simulation as meaning a result that is unlikely to have occurred solely as a result of random selection in sampling or random assignment in an experiment. **Essential Skills and Knowledge** • **Ability to conduct sample surveys, experiments and observational studies** • **Understanding of the limitations of observational studies that do not allow major conclusions on treatments** • **Ability to recognize and avoid bias** S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. <u>Use Nemeth Braille Code for data and calculations.</u> **Note**: For S.IC.4 and 5, focus on the variability of results from experiments—that is, focus on statistics as a way of dealing with, not eliminating, inherent randomness. **Essential Skills and Knowledge** • **Ability to informally establish bounds as to when something is statistically significant** • **Ability to conduct simulations and accurately interpret and use the results** • **Ability to use sample means and sample proportions to estimate population values**	**. Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 4: Inferences and Conclusions from Data		
Cluster	**Standard**	**Practices**
Make inferences and justify conclusions from sample surveys, experiments, and observational studies.	S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. Use Nemeth Braille Code for data and calculations. **Essential Skills and Knowledge** • **Ability to set up and conduct a randomized experiment or investigation, collect data and interpret the results** • **Ability to draw conclusions based on comparisons of simulation versus experimental results** • **Ability to determine the statistical significance of data** S.IC.6 Evaluate reports based on data in Nemeth Braille Code. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

ALGEBRA II

Unit 4: Inferences and Conclusions from Data		
Cluster	**Standard**	**Practices**
Use probability to evaluate outcomes of decisions.	S.MD.6 (+) Use probabilities in Nemeth Braille code to make fair decisions (e.g., drawing by lots, using a random number generator). **Note**: Extend to more complex **probability models**. Include situations such as those involving quality control, or diagnostic tests that yield both false positive and false negative results. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). **Essential Skills and Knowledge** • **Ability to synthesize and apply various probability concepts to evaluate decisions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

GEOMETRY

Unit 1: Congruence, Proof, and Constructions

In previous grades, students were asked to draw triangles based on given measurements. They also have prior experience with rigid motions: translations, reflections, and rotations and have used these to develop notions about what it means for two objects to be congruent. In this unit, students establish triangle congruence criteria, based on analyses of rigid motions and formal constructions. They use triangle congruence as a familiar foundation for the development of formal proof. Students prove theorems—using a variety of formats—and solve problems about triangles, quadrilaterals, and other polygons. They apply reasoning to complete geometric constructions and explain why they work.

Unit 1: Congruence, Proof, and Constructions		
Cluster	**Standard**	**Practices**
Experiment with transformations in the plane.	**Cluster Note*:* Build on student experience with rigid motions from earlier grades. Point out the basis of rigid motions in geometric concepts, e.g., translations move points a specified distance along a line parallel to a specified line; rotations move objects along a circular arc with a specified center through a specified angle.** G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. **Essential Skills and Knowledge** • **Ability to fluently use mathematical vocabulary** G.CO.2 Represent transformations in the plane using, e.g., transparencies and accessible geometry software when available, tactile graphics and drawing tools and manipulatives; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus **horizontal stretch**) **Essential Skills and Knowledge** • **Ability to make connections between function transformations (F.BF.3) and geometric transformations** • **Knowledge that rigid transformations preserve the shape of a figure**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 1: Congruence, Proof, and Constructions		
Cluster	**Standard**	**Practices**
Experiment with transformations in the plane.	G.CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. **Essential Skills and Knowledge** • **Ability to use appropriate vocabulary to describe the rotations and reflections** • **Ability to use the characteristics of a figure to determine and then describe what happens to the figure as it is rotated (such as axis of symmetry, congruent angles or sides….)** G.CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. **Essential Skills and Knowledge** • **Ability to construct a definition for each term based upon a synthesis of experiences** G.CO.5 Given a tactile graphic of geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., raised line graph paper, tactile drawing tools, ~~tracing paper~~, or acccesible geometry software when it becomes available. Specify a sequence of transformations that will carry a given figure onto another. **Essential Skills and Knowledge** • **Ability to interpret and perform a given sequence of transformations and draw the result** • **Ability to accurately use geometric vocabulary to describe the sequence of transformations that will carry a given figure onto another**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning** .

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Unit 1: Congruence, Proof, and Constructions		
Cluster	**Standard**	**Practices**
Understand congruence in terms of rigid motions.	**Cluster Note*:* Rigid motions are at the foundation of the definition of congruence. Students reason from the basic properties of rigid motions (that they preserve distance and angle), which are assumed without proof. Rigid motions and their assumed properties can be used to establish the usual triangle congruence criteria, which can then be used to prove other theorems.** G.CO.6 Use geometric descriptions of **rigid motions** to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of **rigid motions** to decide if they are congruent. **Essential Skills and Knowledge** • **Ability to recognize the effects of rigid motion on orientation and location of a figure** • **Ability to use rigid motions to map one figure onto another** • **Ability to use the definition of congruence as a test to see if two figures are congruent** G.CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. **Essential Skills and Knowledge** • **Knowledge of vocabulary corresponding parts and the connection to the given triangles** • **Ability to identify the corresponding parts of two triangles** G.CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. **Essential Skills and Knowledge** • **Ability to recognize why particular combinations of corresponding parts establish congruence and why others do not** • **Ability to show why congruence of particular combinations of corresponding parts do not establish congruence of the triangles**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 1: Congruence, Proof, and Constructions		
Cluster	**Standard**	**Practices**
Prove geometric theorems.	**Cluster Note: Encourage multiple ways of writing proofs, such as in narrative paragraphs, using flow diagrams, in two column format, and using diagrams without words. Students should be encouraged to focus on the validity of the underlying reasoning while exploring a variety of formats for expressing that reasoning.** G.CO.9 Given tactile graphics an using Nemeth Braille Code, prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.* **Note: This is an overarching standard that will be revisited throughout the course.** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** G.CO.10 Given tactile graphics and using Nemeth Braille Code, prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.* **Note**: Implementation of this standard may be extended to include concurrence of perpendicular bisectors and angle bisectors as preparation for **G.C.3** in Unit 5. **Essential Skills and Knowledge** • **Ability to construct a proof using one of a variety of methods**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 1: Congruence, Proof, and Constructions		
Cluster	**Standard**	**Practices**
	G.CO.11 Given tactile graphics an using Nemeth Braille Code, prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.* **Essential Skills and Knowledge** • **Ability to construct a proof using one of a variety of methods**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Make geometric constructions.	**Cluster Note: Build on prior student experience with simple constructions. Emphasize the ability to formalize and explain how these constructions result in the desired objects. Some of these constructions are closely related to previous standards and can be introduced in conjunction with them.** G.CO.12 Make formal geometric constructions with a variety of tools and methods (tactile compass and straightedge, string, ~~reflective devices~~, paper folding, accessible dynamic geometric software when it becomes available, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.* **Essential Skills and Knowledge** • **Ability to use understanding of geometric concepts to establish a rationale for the steps/procedures used in completing a construction** G.CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle using tactile drawing tools. **Essential Skills and Knowledge** • **Ability to use understanding of geometric concepts to establish a rationale for the steps/procedures used in completing a construction**	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 2: Similarity, Proof, and Trigonometry

Students apply their earlier experience with dilations and proportional reasoning to build a formal understanding of similarity. They identify criteria for similarity of triangles, use similarity to solve problems, and apply similarity in right triangles to understand right triangle trigonometry, with particular attention to special right triangles and the Pythagorean Theorem. Students develop the Laws of Sines and Cosines in order to find missing measures of general (not necessarily right) triangles, building on students' work with quadratic equations done in the first course. They are able to distinguish whether three given measures (angles or sides) define 0, 1, 2, or infinitely many triangles.

Unit 2: Similarity, Proof, and Trigonometry		
Cluster	**Standard**	**Practices**
Understand similarity in terms of similarity transformations.	G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor. a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. **Essential Skills and Knowledge** • **Ability to connect experiences with dilations and orientation to experiences with lines** b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor. **Essential Skills and Knowledge** • **Ability to develop a hypothesis based on observations** G.SRT.2 Given tactile graphics of two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using Nemeth Braille Code using **similarity transformations** the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. **Essential Skills and Knowledge** • **Ability to make connections between the definition of similarity and the attributes of two given figures** • **Ability to set up and use appropriate ratios and proportions**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 2: Similarity, Proof, and Trigonometry		
Cluster	**Standard**	**Practices**
	G.SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. **Essential Skills and Knowledge** • **Ability to recognize why particular combinations of corresponding parts establish similarity and why others do not**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.**
Prove theorems involving similarity.	G.SRT.4 Given tactile graphics and Nemeth Braille Code, prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two sides proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.* **Essential Skills and Knowledge** • **Ability to construct a proof using one of a variety of methods** G.SRT.5 Given tactile graphics and Nemeth Braille Code, use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **Note: This is an overarching standard that will be revisited throughout the course.** **Essential Skills and Knowledge** • **Ability to use information given in verbal or pictorial form about geometric figures to set up a proportion that accurately models the situation**	**Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 2: Similarity, Proof, and Trigonometry		
Cluster	**Standard**	**Practices**
Define trigonometric ratios and solve problems involving right triangles.	G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. **Essential Skills and Knowledge** • **Ability to generalize that side ratios from similar triangles are equal and that these relationships lead to the definition of the six trigonometric ratios** G.SRT.7 Explain and use the relationship between the sine and cosine of complementary angles <u>using tactile graphics and Nemeth Braille Code.</u> **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems <u>using tactile graphics and Nemeth Braille Code.</u> ★ **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 2: Similarity, Proof, and Trigonometry		
Cluster	**Standard**	**Practices**
Apply geometric concepts in modeling situations.	**Cluster Note: Focus on situations well modeled by trigonometric ratios for acute angles** **Note: These are overarching standards that have applications in multiple units** G.MG.1 Use geometric shapes, their measures, and their properties to describe objects. (e.g., modeling a tree trunk or a human torso as a cylinder). ★ **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** G.MG.2 Apply concepts of **density** based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot) . ★ **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with **typographic grid systems** based on ratios). ★ **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 2: Similarity, Proof, and Trigonometry		
Cluster	**Standard**	**Practices**
Apply trigonometry to general triangles.	**Cluster Note: With respect to the general case of the Laws of Sines and Cosines, the definitions of sine and cosine must be extended to obtuse angles.** G.SRT.9 (+) Using Nemeth Braille Code and tactile graphics, derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side with tactile drawing tools. **Essential Skills and Knowledge** • **Ability to make connections between the formula $A = \frac{1}{2}(base)(height)$ and right triangle trigonometry** G.SRT.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to recognize when it is appropriate to use the Law of Sines and the Law of Cosines** G.SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles using Nemeth Braille Code. (e.g., surveying problems, resultant forces). **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 3: Extending to Three Dimensions

Students' experience with two-dimensional and three-dimensional objects is extended to include informal explanations of circumference, area and volume formulas. Additionally, students apply their knowledge of two-dimensional shapes to consider the shapes of cross-sections and the result of rotating a two-dimensional object about a line.

Unit 3: Extending to Three Dimensions		
Cluster	**Standard**	**Practices**
Explain volume formulas and use them to solve problems.	**Cluster Note: Informal arguments for area and volume formulas can make use of the way in which area and volume scale under similarity transformations: when one figure in the plane results from another by applying a similarity transformation with scale factor k, its area is k^2 times the area of the first. Similarly, volumes of solid figures scale by k^3 under a similarity transformation with scale factor k.** G.GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use* ***dissection arguments***, ***Cavalieri's principle***, *and* ***informal limit arguments***. *Use Nemeth Code as needed.* **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems using Nemeth Braille Code.★ **Note: This is an overarching standard that has applications in multiple units** **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 3: Extending to Three Dimensions		
Cluster	**Standard**	**Practices**
Visualize the relation between two dimensional and three-dimensional objects.	G.GMD.4 Identify the shapes of two-dimensional cross-sections of three dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. Use tactile graphics with written descriptions to represent pictures. **Essential Skills and Knowledge** • **Ability to make connections between two-dimensional figures such as rectangles, squares, circles, and triangles and three-dimensional figures such as cylinders, spheres, pyramids and cones**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 3: Extending to Three Dimensions		
Cluster	**Standard**	**Practices**
Apply geometric concepts in modeling situations.	G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). ★ **Note**: Focus on situations that require relating two- and three-dimensional objects, determining and using volume, and the trigonometry of general triangles. **Note: This is an overarching standard that has applications in multiple units.** **Essential Skills and Knowledge** • **Ability to connect experiences with this standard as it related to the two- dimensional shapes studied in Unit 2 to three-dimensional shapes**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 4: Connecting Algebra and Geometry Through Coordinates

Building on their work with the Pythagorean theorem in 8th grade to find distances, students use a Cartesian coordinate system to verify geometric relationships, including properties of special triangles and quadrilaterals and slopes of parallel and perpendicular lines, which relates back to work done in the first course. Students continue their study of quadratics by connecting the geometric and algebraic definitions of the parabola.

Unit 4: Connecting Algebra and Geometry Through Coordinates		
Cluster	**Standard**	**Practices**
Use coordinates to prove simple geometric theorems algebraically.	**Cluster Note: This unit has a close connection with the next unit. For example, a curriculum might merge G.GPE.1 and the Unit 5 treatment of G.GPE.4 with the standards in this unit. Reasoning with triangles in this unit is limited to right triangles; e.g., derive the equation for a line through two points using similar right triangles.** G.GPE.4 Use coordinates to prove simple geometric theorems algebraically using Nemeth Braille Code. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle.* **Note: This is an overarching standard that has applications in multiple units** **Essential Skills and Knowledge** • **Ability to use distance, slope and midpoint formulas,…** G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems in Nemeth Braille Code. (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). **Note**: Relate work on parallel lines in this standard to work on **A.REI.5** in High School Algebra I involving systems of equations having no solution or infinitely many solutions. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 4: Connecting Algebra and Geometry Through Coordinates		
Cluster	**Standard**	**Practices**
Use coordinates to prove simple geometric theorems algebraically (continued from the previous page)	GPE.6 Using tactile graphics and Nemeth Braille Code, find the point on a **directed line segment** between two given points that partitions the segment in a given ratio. **Essential Skills and Knowledge** • **Ability to use the distance formula and the Pythagorean theorem** G.GPE.7 Using tactile graphics and Nemeth Braille Code, use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.★ **Note**: This standard provides practice with the distance formula and its connection with the Pythagorean theorem. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 4: Connecting Algebra and Geometry Through Coordinates		
Cluster	**Standard**	**Practices**
Translate between the geometric description and the equation for a conic section.	G.GPE.2 Using tactile graphics and Nemeth Braille Code, derive the equation of a parabola given a **focus** and **directrix**. **Note:** The **directrix** should be parallel to a coordinate axis. **Essential Skills and Knowledge** • **Ability to connect the distance formula and the definition of a parabola** • **Ability to connect the algebraic and geometric definitions of a parabola**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 5: Circles With and Without Coordinates

In this unit students prove basic theorems about circles, such as a tangent line is perpendicular to a radius, inscribed angle theorem, and theorems about chords, secants, and tangents dealing with segment lengths and angle measures. They study relationships among segments on chords, secants, and tangents as an application of similarity. In the Cartesian coordinate system, students use the distance formula to write the equation of a circle when given the radius and the coordinates of its center. Given an equation of a circle, they draw the graph in the coordinate plane, and apply techniques for solving quadratic equations, which relates back to work done in the first course, to determine intersections between lines and circles or parabolas and between two circles.

Unit 5: Circles With and Without Coordinates		
Cluster	**Standard**	**Practices**
Understand and apply theorems about circles.	G.C.1 Using Nemeth Braille Code, prove that all circles are similar. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** G.C.2 Using tactile graphics and Nemeth Braille Code, Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.* **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.** G.C.3 Using tactile graphics, tactile drawing tools, and Nemeth Braille Code, construct the inscribed and circumscribed circles of a triangle and prove properties of angles for a quadrilateral inscribed in a circle. **Essential Skills and Knowledge** • **Ability to use concurrence of perpendicular bisectors and angle bisectors for the basis of the construction**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 5: Circles With and Without Coordinates		
Cluster	**Standard**	**Practices**
	G.C.4 (+) Given tactile graphics and tactile drawing tools, construct a tangent line from a point outside a given circle to the circle. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.**
Find arc lengths and areas of sectors of circles.	G.C.5 Using Nemeth Braille Code and tactile graphics, derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. **Note**: Emphasize the similarity of all circles. Note that by similarity of sectors with the same central angle, arc lengths are proportional to the radius. Use this as a basis for introducing radian as a unit of measure. It is not intended that it be applied to the development of circular Trigonometry in this course. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 5: Circles With and Without Coordinates		
Cluster	**Standard**	**Practices**
Translate between the geometric description and the equation for a conic section.	G.GPE.1 Using Nemeth Braille Code and tactile graphics, derive the equation of a circle of given center and radius using the Pythagorean theorem; **complete the square** to find the center and radius of a circle given by an equation. **Essential Skills and Knowledge** • **See the skills and knowledge that are stated in the Standard.**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 5: Circles With and Without Coordinates		
Cluster	**Standard**	**Practices**
Use coordinates to prove simple geometric theorems algebraically.	G.GPE.4 Use coordinates to prove simple geometric theorems algebraically in Nemeth Braille Code; *for example prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).* **Note**: Include simple proofs involving **circles**. **Note: This is an overarching standard that has applications in multiple units** **Essential Skills and Knowledge** • **Ability to connect experience with coordinate proofs from Unit 4 to circles**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 5: Circles With and Without Coordinates		
Cluster	**Standard**	**Practices**
Apply geometric concepts in modeling situations.	G.MG.1 Use geometric shapes, their measures, and their properties to describe objects. (e.g., modeling a tree trunk or a human torso as a cylinder). ★ **Note**: Focus on situations in which the analysis of **circles** is required. **Note: This is an overarching standard that has applications in multiple units** **Essential Skills and Knowledge** • **Ability to connect experiences from Unit 2 and Unit 3 with two dimensional and three dimensional shapes to circles**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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GEOMETRY

Unit 6: Applications of Probability

Building on probability concepts that began in the middle grades, students use the languages of set theory to expand their ability to compute and interpret theoretical and experimental probabilities for compound events, attending to mutually exclusive events, independent events, and conditional probability. Students should make use of **geometric probability models** wherever possible. They use probability to make informed decisions.

Unit 6: Applications of Probability		
Cluster	**Standard**	**Practices**
Understand independence and conditional probability and use them to interpret data.	S.CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events using Nemeth Braille Code ("or," "and," "not"). **Note**: Build on work with two-way tables from Algebra I Unit 3 **(S.ID.5)** to develop understanding of conditional probability and independence. **Essential Skills and Knowledge** • **Ability to describe a sample space** • **Understanding of and ability to use set notation, key vocabulary and graphic organizers linked to this standard** S.CP.2 Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent. **Essential Skills and Knowledge** • **Ability to determine the conditional probability of an event given that another event occurs** • **Ability to determine the probability of an event given the probability of a complementary event** • **Ability to determine if two events are dependent or independent**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 6: Applications of Probability		
Cluster	**Standard**	**Practices**
Understand independence and conditional probability and use them to interpret data.	S.CP.3 Understand the **conditional probability** of *A* given *B* as *P(A and B)/P(B),* and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B,* using Nemeth Braille Code **Essential Skills and Knowledge** • **Understanding of and ability to use set notation, key vocabulary and graphic organizers linked to this standard** S.CP.4 Construct and interpret two-way frequency tables of data using Nemeth Braille Code, when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* **Essential Skills and Knowledge** • **Ability to connect experience with two-way frequency tables from Algebra I to sample spaces** • **Knowledge of the characteristics of conditional probability** S.CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* **Essential Skills and Knowledge** • **Ability to make connections between statistical concepts and real world situations**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 6: Applications of Probability		
Cluster	**Standard**	**Practices**
Use the rules of probability to compute probabilities of compound events in a uniform probability model.	S.CP.6 Using Nemeth Braille Code, find the **conditional probability** of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model. **Essential Skills and Knowledge** • **Ability to analyze a situation to determine the conditional probability of a described event given that another event occurs** S.CP.7 Apply the Addition Rule, *P(A or B) = P(A) + P(B) – P(A and B)*, and interpret the answer in terms of the model using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to analyze a situation to determine the conditional probability of a described event given that another event occurs** • **Ability to make connections between numeric results and context** S.CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, *P(A and B) = P(A)P(B|A) = P(B)P(A|B)*, and interpret the answer in terms of the model using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to analyze a situation to determine the probability of a described event** • **Ability to make connections between numeric results and context** S.CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems using Nemeth Braille Code. **Essential Skills and Knowledge** • **Ability to use formulas containing factorial notation** • **Ability to analyze a situation to determine the probability of a described event**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Unit 6: Applications of Probability		
Cluster	**Standard**	**Practices**
Use probability to evaluate outcomes of decisions.	S.MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). **Essential Skills and Knowledge** • **Ability make connections between the numeric probabilities and context** • **Knowledge of the Law of Large Numbers** **Note**: This unit sets the stage for work in Algebra II, where the ideas of **statistical inference** are introduced. Evaluating the risks associated with conclusions drawn from sample data (i.e. incomplete information) requires an understanding of probability concepts. S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). **Essential Skills and Knowledge** • **Knowledge of and ability to use a variety of data collection techniques** • **Ability make connections between the numeric probabilities and context** • **Knowledge of the Law of Large Numbers**	**Make sense of problems and persevere in solving them.** **Reason abstractly and quantitatively.** **Construct viable arguments and critique the reasoning of others.** **Model with mathematics.** **Use appropriate tools strategically.** **Attend to precision.** **Look for and make use of structure.** **Look for and express regularity in repeated reasoning.**

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Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

This document contains braille and tactile graphics organized by grade level or course. This is not meant to be an all-inclusive list of all Nemeth Braille Code and tactile graphics available. A more complete list can be found in the resources contained in Appendix C.

Pre Kindergarten

Nemeth Braille Code

	Mathematical Sign	Nemeth Symbol
Numeric indicator	N/A	⠼
Read numbers 0-10	0 1 2 3 4 5 6 7 8 9 10	⠚ ⠁ ⠃ ⠉ ⠙ ⠑ ⠋ ⠛ ⠓ ⠊ ⠚ ⠁ ⠚
Punctuation indicator	1.	⠼ ⠁ ⠼ ⠂
Transcriber's note symbols Opening Closing	N/A	⠠ ⠠ ⠠ ⠠

Tactile Graphics

	Mathematical Sign	Braille
Number line	↔	Tactile graphic
Square	□	Tactile graphic
Circle	○	Tactile graphic
Triangle	△	Tactile graphic
Rectangle	▭	N/A
Objects	Example: picture of a car	Tactile graphic Represented with simple, solid shapes (Example: rectangle)

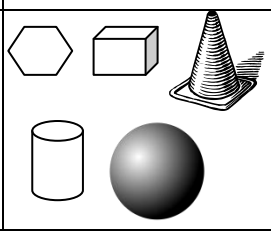
Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Kindergarten

Nemeth Braille Code

	Mathematical Sign	Nemeth Symbol
Hyphen	-	⠤
Read and write numbers 0-20	0-20	⠼⠁ ⠼⠃ ⠼⠉ ⠼⠙ ⠼⠑
Mathematical comma	,	⠂
Ellipse	2, 3, 4, …	⠼⠃ ⠂ ⠼⠉ ⠼⠙ ⠂ ⠂ ⠂
Plus	+	⠖
Minus	-	⠤
Equal to	=	⠶
Write equations in horizontal format	1+2 = 3	⠼⠁ ⠖ ⠼⠃ ⠶ ⠼⠉

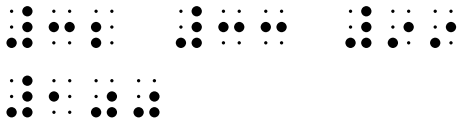
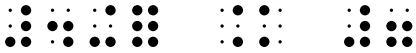
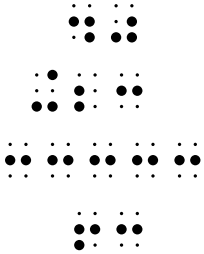
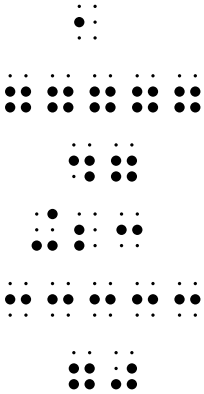
Tactile Graphics

	Mathematical Sign	Braille
Hundreds chart	N/A	Adapted Manipulative or Tactile Graphic with Nemeth Braille Code Numbers
Hexagon, cube, cone, cylinder, sphere		Tactile graphic

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

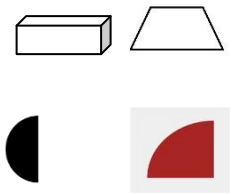
Grade 1

Nemeth Braille Code

	Mathematical Sign	Braille
Numbers 21-120	32 33 99 100	
Tally marks	~~IIII~~	
Shape indicator	N/A	
Horizontal equations with question mark or blank space for omission	4 + ? = 7 4 + = 7	
Horizontal equations with blank line for omission	4 + __ = 7	
Horizontal equations with box/square for omission	4 + □ = 7	
Spatial arrangements of addition and subtraction Separation line extending one space on each side of arrangement	40 +23 _____ 63	
Carried number indicator	1 47 +23 _____ 70	
Less than	2 < 4	
Greater than	5 > 1	

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Tactile Graphics

	Mathematical Sign	Braille
Rectangular prisms, trapezoid, half-circle, quarter circle		Tactile graphics

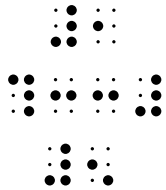
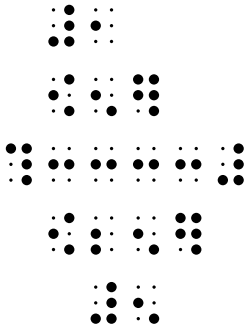
Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Grade 2

Nemeth Braille Code

	Mathematical Sign	Nemeth Symbol
Numbers to 1000	500 875 1000	⠼⠑⠚ ⠼⠓⠛⠑ ⠼⠁⠚⠚⠚
Colon	:	⠒
Decimal point	.	⠨
Time	3:00	⠼⠉⠒⠚⠚
Money	Pictures of currency and coins	Penny – pn, nickel – nk, dime – dm, quarter – qr
Cent sign	5¢	⠼⠑⠈⠉
Dollar sign	$1.00	⠈⠙ ⠼⠁⠚⠚
Reading a key to a graph	N/A	Contains Nemeth Braille Code and sometimes tactile graphics
Horizontal fraction bar	____	⠨
Simple fraction with horizontal bar	2 ____ 3	⠼⠃⠨⠼⠉
Diagonal fraction bar	/	⠸⠌
Simple fraction with a diagonal bar	2/3	⠼⠃⠸⠌⠼⠉

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Read spatial arrangements of fractions	$\frac{1}{5}$	
Termination indicator	N/A	
Cancellation indicator (used in examples of spatial arrangements, not for computation)	$\frac{1\cancel{5}}{\cancel{25}5}$	

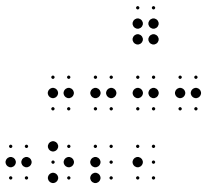
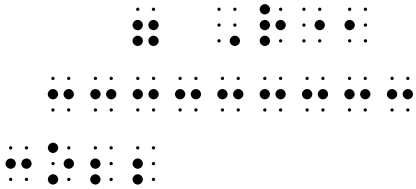
Tactile Graphics

	Mathematical Sign	Nemeth Symbol
Ruler (nearest inch, centimeter, foot, yard, meter)	N/A	Tactile graphics
Clocks (nearest 5 minutes)	N/A	Tactile graphic
Dot (Line) plot (read and create)	Number line with Xs plotted horizontally above numbers for data points	Number line is a tactile graphic with a full cell to represent each X for plotted points
Picture graph (read and create)	N/A	Lines created as a tactile graphic with Nemeth Braille Code labels. A full cell represents each picture
Bar graph (read and create)	N/A	Tactile graphic with Nemeth Braille Code labels
Quadrilaterals, pentagons		Tactile graphic

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

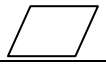
Grade 3

Nemeth Braille Code

	Mathematical Sign	Nemeth Symbol
Multiplication cross	**x**	
Multiplication dot	•	
Division	÷	
Division cage (spatial format)	7 3) 21	
Division cage (linear format)	3) 21	
Multipurpose indicator	N/A	
Remainder	7 R1 3) 22	
Parentheses	(5, 10)	
English letter indicator	N/A	
Picture graph with 2:1 scale (read and create)	N/A	Lines created as a tactile graphic with Nemeth Braille Code labels. A full cell represents each whole picture Dots 4, 5, 6 represent each half picture

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

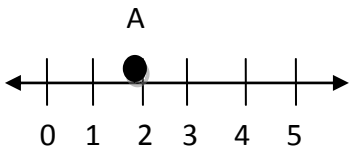
Tactile Graphics

	Mathematical Sign	Nemeth Symbol
Rhombus		Tactile graphic
Right angle		N/A
Area and perimeter	N/A	Tactile graphics

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Grade 4

Nemeth Braille Code

	Mathematical Sign	Nemeth Symbol
Number line		Beginning in grade 4, all number lines are done using Nemeth Braille Code symbols Axis Line Left arrow Right arrow Scale/tick mark Solid point
Dot (Line) plot (read and create)	Number line with Xs plotted vertically above numbers for data points	Dot (Line) Plot Number lines are created using Nemeth Braille Code symbols Axis Line Left arrow Right arrow Scale/tick mark X

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Tables		Top of box Separation line after heading Bottom of box Guide dots
Degree	5°	
Mixed numeral with diagonal fraction bar	4 3/4	
Circle		
Triangle		
Diamond		
Square		
Star		
Rectangle		
Angle	∠	
Angle ABC	∠ABC	
Directly over indicator	N/A	
Line AB	AB	
Line segment AB	AB	
Ray AB	AB	
Parallel	||	

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Perpendicular	$\perp$	⠸⠩

Tactile Graphics

	Mathematical Sign	Nemeth Symbol
Point	$\bullet$	Tactile graphic
Angle	$\angle$	Tactile graphic
Line	$\longleftrightarrow$	Tactile graphic
Ray	$\longrightarrow$	Tactile graphic
Line segment	$\overline{}$	Tactile graphic

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Grade 5

Nemeth Braille Code

	Mathematical Sign	Nemeth symbol
Set braces	$\{\ \}$	⠸⠷ ⠸⠾
Brackets	$[\ ]$	⠸⠣ ⠸⠜
Ordered pair	(a, b)	⠐⠣⠁⠂⠃⠜
Exponent (superscript)	3^2	⠰⠉⠰⠃
Baseline indicator	2^2+3^2	⠰⠃⠰⠃⠬⠰⠉⠰⠃

Tactile Graphics

	Mathematical Sign	Nemeth symbol
Coordinate grid (axis, origin)	N/A	Tactile graphics

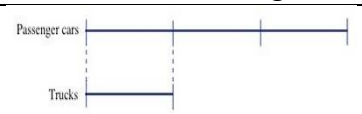
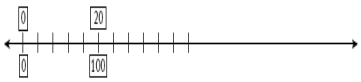
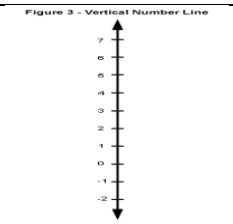
Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Grade 6

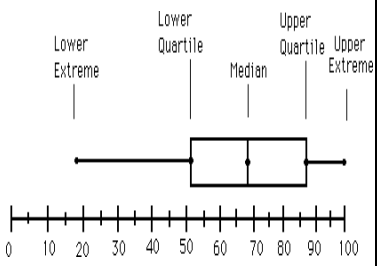
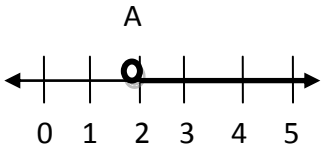
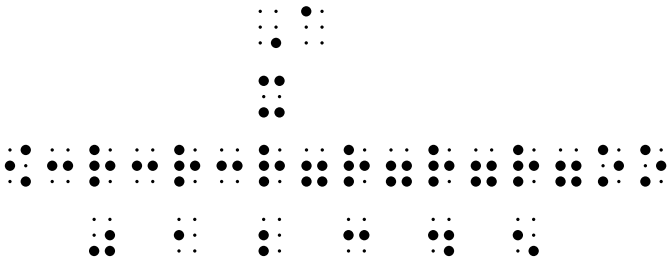
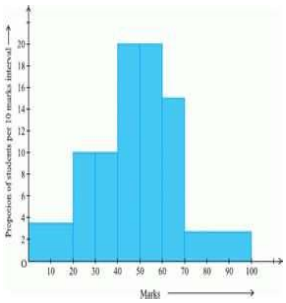
Nemeth Braille Code

	Mathematical Sign	Nemeth symbol
Not equal to	≠	⠨⠅
Ratio	2 : 4	⠼⠆ ⠒ ⠼⠲
Percent	%	⠨⠴
Absolute value of x	|x|	⠳⠭⠳
Is less than or equal to	≤	⠸⠅
Is greater than or equal to	≥	⠸⠕
Negative number	–(–3) = 3	⠤⠤⠼⠉⠤ ⠒ ⠼⠉
Use of variable in expressions	$A=6s^2$	⠁⠨⠅ ⠋⠎⠘⠆

Tactile Graphics

	Mathematical Sign	Nemeth symbol
Tape diagram		Tactile graphic
Double number line diagrams		Nemeth Braille Code Number line
Vertical number line		Nemeth Braille Code number line

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Box plot or Box and whisker plot		Nemeth Braille Code Number Line with tactile graphics for box and whiskers
Number line with inequality		Axis line Bold axis line Open point Solid point Bold right arrow Bold right arrow 
Histogram		Nemeth Braille Code number line and tactile graphic for bars of data

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Grade 7

Nemeth Braille Code

	Mathematical Sign	Nemeth symbol
Measure of $\angle ABC$	$m\angle ABC$	⠍⠈⠯⠁⠃⠉
Complex fraction indicators opening/closing with horizontal line opening/closing with diagonal line	$\frac{\frac{3}{8}}{5}$ $\frac{2/3}{3/2}$	⠈⠌⠼⠉⠦⠼⠓⠈⠌⠼⠑ ⠈⠌⠼⠃⠸⠌⠼⠉⠈⠌⠼⠉⠸⠌⠼⠃
Repetend (horizontal modifying bar)	$3.33\overline{3}$	⠼⠉⠨⠼⠉⠉⠉
Rectangle	N/A	⠷⠾
Triangle	N/A	⠷⠁
Is approximately equal to	≈	⠈⠕⠈⠕
Is congruent to	≅	⠈⠕⠈⠕⠈⠕
Is similar to	~	⠈⠕⠈⠕
Triangle with vertices *A, B,* and *C*	ΔABC	⠠⠁⠃⠉
Circle	N/A	⠷⠷
Greek letter indicator	N/A	⠨
Pi	π	⠨⠷
Slope (using capital delta)	$\frac{\Delta y}{\Delta x}$	⠠⠙⠽⠸⠌⠠⠙⠭

Tactile Graphics

	Mathematical Sign	Nemeth symbol
Tree diagram	N/A	Tactile graphic

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Grade 8

Nemeth Braille Code

	Mathematical Sign	Nemeth symbol
Principle square root of x	$\sqrt{x}$	⠩
Index of radical	$(\sqrt[3]{8})^3 = 8$	⠼⠉⠩⠼⠓ ⠨⠹ ⠨⠹
Negative exponent	3^{-3}	⠼⠉⠰⠤⠼⠉
Exponent in denominator	$\frac{1}{3^3}$	⠼⠁⠌⠼⠉⠰⠼⠉
A prime	A'	⠁⠄
A double prime	A''	⠁⠄⠄
Transformational notation	**∠A → ∠A' → ∠A"**	⠈⠁ ⠳ ⠈⠁⠄ ⠳ ⠈⠁⠄⠄

Tactile Graphics

	Mathematical Sign	Nemeth symbol
Scatter plot	N/A	Tactile graphic
Line graph	N/A	Tactile graphic

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

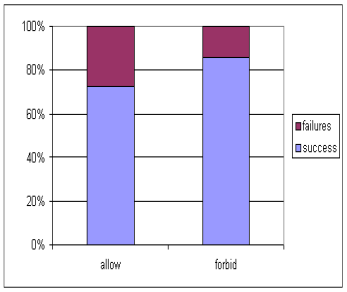
Algebra 1/Data Analysis

Nemeth Braille Code

	Mathematical Sign	Nemeth symbol
Value of the function *f* at *x*	$f(\mathrm{x})$	⠍⠷⠭
Exponent to the exponent	$\left(5^{\frac{1}{3}}\right)^{3} = 5^{\left(\frac{1}{3}\right)3}$	⠘⠢⠘⠌⠘⠢⠘⠌⠘⠢⠘⠌

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

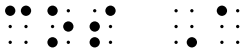
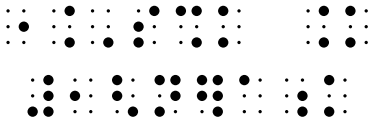
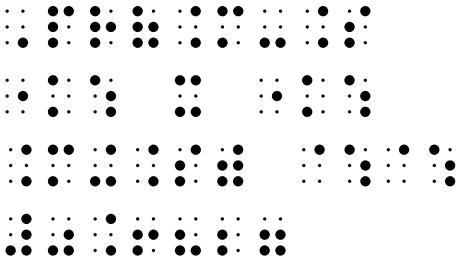
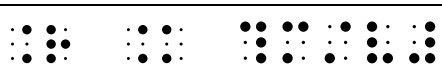
Tactile Graphics

	Mathematical Sign	Nemeth symbol
Segmented bar graph		Tactile graphic

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Algebra 2

Nemeth Braille Code

	Mathematical Sign	Nemeth symbol
Arc with endpoints *A* and *B*		
Sine of *A*	sin A	
Cosine A	cos A	
Tangent of A	tan A	
Logarithm	(xy) = log	
Directly under indicator	N/A	
Subscript	4	
The summation *a1+a2+ ... +an.*	$\sum_{k=1}^{n} a_k$	
n factorial	$n!$	
Theta	θ	
Empirical rule: μ is the mean of the distribution (Greek letter lower case mu) σ is its standard deviation (Greek letter lower case sigma)	$\Pr(\mu - \sigma \le x \le \mu + \sigma) \approx 0.6827$	
Formula for density (Greek letter lower case rho)	**ρ = m/v**	

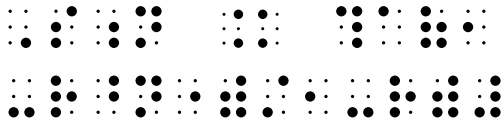
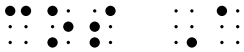
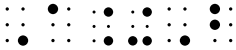
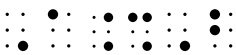
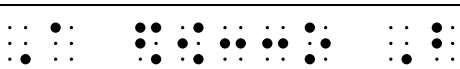
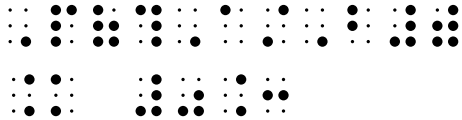
Tactile Graphics

	Mathematical Sign	Nemeth symbol
NONE		

Appendix A: BRAILLE AND TACTILE GRAPHICS FOR MATHEMATICS CHARTS BY GRADE LEVEL AND COURSE

Geometry

Nemeth Braille Code

	Mathematical Sign	Nemeth symbol
Base *a,* of b (subscript)	$S_n = \frac{a\ 1-r^n}{1-r}$	
Sine of *A*	sin A	
Cosine A	cos A	
Therefore	∴	
Union	A ∪ B	
Intersection	A ∩ B	
Complement	A^c	
Corresponds to	A ⟺ B	
Conditional probability	$P(A/B) = 0.3$	

Tactile Graphics

	Mathematical Sign	Nemeth symbol
NONE		

Appendix B: Acronyms and Definitions

This document contains acronyms and terms and their definitions, which are often used within the field of education of students who are blind or visually impaired. While not all of the acronyms and terms are found in the Maryland Common Core State Curriculum Frameworks for Braille , they may be encountered as the Frameworks are implemented.

Braille Authority of North America (BANA) is an organization comprised of one representative from each of the many member organizations in the field of blindness that serves on the BANA Board. The BANA's purpose is to promote and facilitate the use, teaching, and production of braille. The BANA publishes rules, interprets and renders opinions pertaining to braille in all existing and future codes. The BANA deals with codes now in existence or to be developed in the future, in collaboration with other countries using English braille. The BANA works largely through committees composed of braille transcribers, braille readers, education and rehabilitation professionals, and Board Members. More information can be found at: http://www.brailleauthority.org

Braille embosser is a printer, that when connected to a computer or electronic braille notetaker, can print hardcopy braille documents that have been translated into braille.

Braille translation software translates and formats documents into braille. Braille translation software requires the user to have knowledge of braille codes and formats to ensure accuracy.

Braillewriter is a manual or electric device used to write braille.

Certified braille transcriber transcribes print materials into braille versions. After completing coursework and tests, a person can become certified as a transcriber in literary braille through the National Library Service for the Blind and Physically Handicapped (NLS). The NLS offers additional certification for literary certified transcribers in the Nemeth Code for Mathematics and Science and Music braille. More information can be found at: http://www.nfb.org/nfb/Braille_Certification.asp

Clusters are statements within a domain in the Maryland Common Core State Curriculum Frameworks. Clusters are focused but still broad and not measureable. For example, in the domain, "Number and Operations in Base Ten" the cluster statement is "Use place value understanding and properties of operations."

Construct is to use tools such as a straightedge and compass to create a mathematical construction. Students who use braille can use a braille ruler as a straightedge, a tactile compass, and paper that creates raised lines to create mathematical construction.

Curriculum is the instructional program(s) used to meet standards that consists of activities, lessons, and instructional materials, tools/strategies.

Appendix B: Acronyms and Definitions

Domains are broad groupings of standards in the Maryland Common Core State Curriculum Frameworks. For example, in the National Common Core State Standards for Mathematics, "Number and Operations in Base Ten" is a domain area across many grade levels with differing clusters and standards for each grade.

Draw is to use measurement tools (ruler and protractor) to create a drawing. Students who read braille can use a braille ruler, braille protractor, and paper that creates raised lines to draw mathematical diagrams.

Electronic braille notetaker is a portable device for producing braille. Electronic braille notetakers typically have some ability to edit and save writing. Many electronic braille notetakers have more advanced features such as word processing, spreadsheets, calculators, calendars, task lists, Global Positioning Systems (GPS) software, book readers, and internet and email access. All electronic braille notetakers have speech output and can have keys for braille input for a QWERTY keyboard. Some can produce braille directly, while others need to be connected to a braille embosser for braille output. Some have a "refreshable braille display," a line of braille cells with pins that continually refresh to display in braille the current line in a document or a menu.

Functional Vision Assessment is an assessment conducted by a teacher of the blind and visually impaired to evaluate a student's performance of tasks in a variety of environments requiring the use of both near and distance vision.

IEP is an Individualized Education Program for a student with a disability that specifies the placement, services, goals/objectives, program supports, and accommodations required as part of the child's educational program.

MIRC is the Maryland Instructional Resource Center for Students with Visual Impairments. The MIRC is funded by the Maryland State Department of Education (MSDE) and housed at the Maryland School for the Blind (MSB). The MIRC serves as a lending library and purchasing facility for all large print and braille textbooks for local school systems (LSSs). The MIRC is also the American Printing House for the Blind Ex Officio Trustee and thus maintains a registry of all blind students in Maryland, manages the Federal Quota funds, and purchases instructional materials for qualifying students in Maryland.

Learning Media Assessment is an assessment by a teacher of the blind and visually impaired to determine a student's most appropriate medium for learning. Learning media can include regular print, regular print with optical devices, large print, braille, use of electronic magnification systems, auditory, tactual symbols, pictures, real objects, or a combination of these media.

Appendix B: Acronyms and Definitions

Local School Systems (LSSs) are the public school systems in the twenty-four counties in Maryland.

Manipulatives are concrete objects that are used in mathematics instruction to represent abstract concepts. Examples include unifix cubes, plastic money, tangrams, spinners, fraction bars, geometric figures. Braille readers can sometimes use the same manipulatives as their peers with adaptation of braille lables and tactual indicators. Other times, they need to use manipulatives designed specifically for braille readers. These include Nemeth Braille Code numeral/signs tiles, Cranmer abacus, Brannan cubarithm, textured figures.

Maryland Common Core Curriculum State Frameworks are Maryland's curriculum based upon the National Common Core State Standards, which were adopted by the Maryland State Board on June 22, 2010.

National Braille Association (NBA) is a non-profit organization dedicated to providing continuing education to those who prepare braille. More information can be found at: http://nationalbraille.org/

National Common Core State Standards (NCCSS) are educational standards developed in collaboration with teachers, school administrators, and experts, to provide a clear and consistent framework to prepare students for college and the workforce. The creation of the NCCSS was a state-led initiative coordinated by the National Governor's Association Center for Educational Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) to ensure all students across the United States are prepared to compete globally.

Nemeth Braille Code for Mathematics and Science is a braille code that was developed in 1946 by Dr. Abraham Nemeth for translating mathematical and scientific notation. There are symbols and formats for all areas of mathematics and science including Algebra, Geometry, Calculus, Trigonometry, Biology, and Chemistry.

Objects are everyday items used in mathematics for sorting, counting, patterning, and/or measurement. Examples include candy, erasers, shoes, real money.

Orientation and Mobility (O&M) Specialist is a trained professional that provides services to students who are blind or visually impaired to enable orientation to and safe movement within their environments in school, home, and community. O&M Specialists teach students skills in use of existing vision, spatial and environmental concepts, use of distance low vision devices, and use of the long cane for safe travel.

Appendix B: Acronyms and Definitions

Signs refer to the characters in print. For example, two horizontal lines above and below each other represent the print mathematical sign for equals =.

Sketch is to draw freehand, without the use of tools. A student who reads braille can sketch using paper that has raised lines and tactile drawing tools.

Slate and stylus is a small, portable device for writing braille. Braille dots are embossed on paper within the slate by using a stylus with a pointed tip.

Standards are measurable statements about what students should know and be able to do. Standards define the knowledge and skills students should have within their prekindergarten through grade twelve educational careers so that they will graduate high school able to succeed in entry-level, credit-bearing academic college courses, in workforce training programs, or in a career.

Symbols are characters in braille. For example, dots 4, 6, then dots 1, 3 represent the symbol for the mathematical print sign for equals =.

Tactile graphics are raised pictures/images that convey non-textual information such as maps, graphs, and diagrams. Tactile graphics have labels in braille. Tactile graphics guidelines are followed to determine if an image should be created and if so, how. Some images are not necessary and can be omitted. Some images are substituted with letters, abbreviations, or words.

Tactile drawing tools are used to create raised pictures/images. These can include a spur wheel, stylus, wax, and other embossing tools.

Teacher of the Blind and Visually Impaired (TBVI) is a professional who provides special education services to students who are blind or visually impaired. TBVIs must meet Maryland teacher certification requirements in the area of vision by completing required coursework and meeting specified requirements. TBVIs perform assessments, and develop and implement Individualized Education Programs (IEPs) or Individualized Family Service Plans (IFSPs) for children and youth birth through 21.

Tools are mathematical devices that all students use. Examples: ruler, compass, protractor, calculator. A Braille reader will use also use mathematical tools, but they are specifically designed for braille readers and have tactual markings and braille labels.

Appendix C: Resources

This document contains a list of resources that may be useful when implementing the Maryland Common Core State Curriculum Frameworks for Braille: Mathematics. Inclusion in this list does not constitute an endorsement by the Maryland State Department of Education.

Braille Authority of North America. (2011). *Guidelines and Standards for Tactile Graphics*. Retrieved from: http://www.brailleauthority.org/tg/web-manual/index.html

Castellano, C., & Kosman, D. (1997). *The Bridge to Braille: Reading and School Success for the Young Blind Child.* Baltimore, MD: National Organization of Parents of Blind Children.

Chang, L, White, C, & Abrahmson, L. (1983). *Handbook for Spoken Mathematics (Larry's Speakeasy)*. Livermore, CA: Technical Information Department, Lawrence Livermore National Laboratory, University of California.

Craig, R. (1997). *Learning the Nemeth Braille Code: Manual for Teachers and Students*. Louisville, Kentucky: American Printing House for the Blind.

Edman, P. (1992). *Tactile Graphics*. New York, NY: American Foundation for the Blind.

Kapperman, G., Heinze, T., & Sticken, J. (1997). *Strategies for Developing Mathematics Skills in Students Who Use Braille.* Research and Development, Inc.: Sycamore, IL.

List of Mathematical Symbols. Website. Retrieved from: http://en.wikipedia.org/wiki/Table_of_mathematical_symbols

Ovard, C. Website. *Braille Helps: Quick Reference Braille Guides and Charts.* Retrieved from http://braillehelps.blogspot.com/

National Braille Association. Website. Retrieved from: http://nationalbraille.org/

National Center for Blind Youth in Science. Website. The National Federation of the Blind Jernigan Institute: Baltimore, MD. Retrieved from: http://www.blindscience.org/ncbys/Resources.asp?SnID=403975526

The Nemeth Braille Code for the Mathematics and Science Notation. (1972). Louisville, KY: American Printing House for the Blind.

Perkins Scout. Website. The Perkins School for the Blind: Watertown, MD. Retrieved from: http://www.perkins.org/resources/scout/literacy-and-braille/braille-instruction.html

Appendix C: Resources

Project Math Access. Website. Retrieved from: http://s22318.tsbvi.edu/mathproject/

School Improvement in Maryland. Website. The Maryland State Department of Education. Retrieved from: http://mdk12.org/

Shodor Education Foundation, Inc. Website. *BRL: Braille Through Remote Learning.* Retrieved from http://www.brl.org/index.html

Tactile Graphics. Website. Retrieved from: http://www.tactilegraphics.org/

Texas School for the Blind and Visually Impaired. *Braille Print Protractor: Part 1, Introduction of a Protractor and the APH Braille Print Protractor* (Online Video). Retrieved from: http://www.youtube.com/user/VideoTSBVI

Appendix D: Instructional Materials

Students who read braille should use a variety of instructional materials for mathematics instruction. The student may be able to utilize the same materials that are used with all students, e.g. Unifix cubes. At other times the student may be able utilize the same materials that are used with all students with some adaptation, e.g. place value arrow with braille labels added. At other times, it is appropriate to utilize materials that have been specifically designed for students who read braille. Below are examples of specific instructional materials that may be appropriate and necessary for students who read braille during mathematics instruction. These materials may be acquired from a number of sources including those listed below.

Calculation tools: Talking calculator, Cranmer Abacus, Math Window, Brannam Cubarithm Slate/ Cubes

Manipulatives: StackUps Spatial Reasoning Cubes, Textured Sorting Circles and Shapes, FOCUS in Mathematics Kit, MathBuilders, Geometro Shapes, Braille Number Lines, Braille Clock Models and Tactile Clock Face Sheets, Geometry Tactile Graphics Kit, Fractional Parts of Wholes Set, Braille Multiplication and Division Tables, Braille Math Drill Cards, Braille Hundreds Boards and Manipulatives

Measuring tools: Braille ruler/yardstick/meter stick, Braille Protractor, Tactile Compass

Software: Math Flash (computation drills)

Tactile drawing tools: Stylus, Braille Labels and Sheets, Feel 'n Peel Sheets: Carousel of Textures and Stickers, Quick-Draw Paper, Calendar Kits, Raised Line graph paper, Tactile Graphics Kit, Crafty Graphics, Draftsman Tactile Drawing Board, Graphic Aid for Math, Picture Maker: Wheatley Tactile Diagramming Kit and Textured Strips

Writing devices: Perkins Braillewriter, Mountbatten Brailler, slate/stylus, electronic braille notetakers

Additional Resources

American Printing House for the Blind http://www.aph.org/products/
Exceptional Teaching Aids http://exceptionalteaching.net/mama.html
Humanware http://www.humanware.com/en-usa/home
Independent Living Aids http://www.independentliving.com/
LS&S Group http://www.lssproducts.com/
Math Window http://www.mathwindow.com/

NOTE: Inclusion in the list above does not constitute an endorsement by the Maryland State Department of Education.

DRAFT

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