



# Utah Braille Core Standards

*Aligned with the Utah Core  
Curriculum Standards for  
Math K-6*

**“Mathematics standards are essential to ensure that functionally blind students become literate in mathematics. Multisensory experiences are needed for a blind child to maximize the use of tactile information when learning and applying mathematical concepts.”**

**—Utah State Office of Education**



The Utah State Office of Education  
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for Math K-6*

# Table of Contents

Utah Braille Core Standards Committee .....	1
Special Acknowledgements .....	3
Nemeth Braille Math Code Beliefs.....	4
Introduction.....	5
Early Intervention and Preschool Considerations .....	6
Challenges to Braille Instruction.....	9
Elementary Math Core Curriculum Definitions.....	12
Reliance Upon Effective Assessment Practices.....	13
Based Upon the National Council of Teachers of .....	13
Mathematics Curriculum Focal Points	
Organization of the Elementary Mathematics Core .....	14
Kindergarten.....	15
First Grade.....	20
Second Grade .....	25
Intended Learning Outcomes for .....	31
Third through Sixth Grade Mathematics	
ILOs for Mathematics.....	31
Third Grade .....	34
Fourth Grade.....	42
Fifth Grade .....	51
Sixth Grade .....	59
Appendix A—Prerequisite Braille Note-Taker Skills .....	67
References .....	68



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# Acknowledgements

The Utah State Office of Education wishes to thank all the members of the Utah Braille Core Standards Committee for their hours of devotion and support of this effort.

## *Special Recognitions*

The Utah State Office of Education also wishes to thank our national advisors, and the California Department of Education, for their unselfish contributions to this document, and for their superb expertise in the area of blindness and visual impairments.

**Sharon Sacks, Ph.D.**—Director of Curriculum and Professional Development at the California School for the Blind, American Foundation for the Blind, California State University.

**Missy Garber, Ph.D.**—Pennsylvania College of Optometry; Vision Support Teacher, Montgomery County Intermediate Unit, Pennsylvania; National Center for Leadership in Visual Impairment, Salus University, Pennsylvania.

**The California Department of Education**—We are grateful for the help and support that sustained us through this process. The sharing of knowledge and information to strengthen the educational outcomes for students we serve who are blind or visually impaired is very much appreciated.

**Tony Jepson**—Tony is a member of the board of directors for the Utah Foundation for the Blind. He has been the Jordan School District Vision Specialist for over forty years. Tony has dedicated himself to providing daily living skills instruction in the homes of school-age children. Tony spent hours of individual time working on aligning the Nemeth Braille Code for Mathematics with the Utah State Core Curriculum. He is considered one of the foremost teachers of students with blindness and visual impairments in the country. We applaud and thank him for his efforts to support making these standards in Nemeth Braille Code instruction available to the blind and visually impaired students of the state.

## Nemeth Code for Braille Mathematics Beliefs



- Aligning the instruction of Nemeth Braille Code for Mathematics to the State Core Curriculum allows students who use braille to be included and more alike than different in academic expectations.



- Instruction and learning of the Nemeth Braille Code for Mathematics is as essential for a child who is blind as instruction in and learning of math is for a sighted child.



- The learning of braille at the highest level of instruction, including the Nemeth Braille Code for Mathematics, will allow students to obtain the highest level of lifelong learning.



- Braille users have a compelling emotional tie to braille; the longer a student is a braille user, the stronger the tie.

# Introduction

“The relevance of mathematics to other endeavors enables students to transfer skills gained from mathematics instruction into their other school subjects and into their lives outside the classroom.”

—Utah State Math Core Curriculum

Math is essential for all learners. It is critical that math be considered and addressed in a unique way for a child who is blind or visually impaired. Math is taught to all children through their individual means of communication. For the child who is blind or visually impaired, math is accessed through the Nemeth Braille Code of Mathematics. Nemeth Code is a special type of braille used for math and science notations. This tactile medium for blind and visually impaired students will allow them complete access to the general curriculum. Using the Nemeth Code will ensure successful educational outcomes for these students.

In order to serve the children of the state of Utah who are blind and or visually impaired, this document has been prepared to describe the alignment of instruction of braille to the Utah State Core Curriculum. The Utah State Elementary Math Core Curriculum represents those standards of learning that are essential for all students. They are the ideas, concepts, and skills that provide the foundation on which subsequent learning may be built.

These braille math standards are carefully aligned with the Utah Math Core Curriculum for students at each grade level, kindergarten through sixth grade. The emphasis is on the unique differences in learning through the sense of touch. The skills for Nemeth Braille Code Mathematics instruction have been “inserted” and underlined throughout this document to indicate where the braille instruction differs or is in addition to the regular State Core Curriculum expectations.

# Early Intervention and Preschool Considerations

## **Early Intervention**

In Utah, our Early Intervention Program (EI) for blind and visually impaired students is coordinated through an interagency agreement between the Utah State Health Department, Utah State Office of Education and Utah Schools for the Deaf and the Blind. This collaboration enables early identification of children with sensory disabilities who may be blind, visually impaired or deafblind.

Where children have been found eligible for EI services, the intended instruction is based on early learning skills. These skills include pre-braille, pre-literacy, daily living, gross and fine motor skills, language development, orientation and mobility and socialization skills.

These early intervention services for students with visual impairments set the stage for early literacy. As these skills develop and the child reaches the age of three, the carry-over to preschool expectations for early literacy will be established.

## **Preschool**

Preschools should enable the child to progress toward achieving age-appropriate and developmental milestones. They are designed to impart life experiences and learning expectations for school achievement, and to teach concepts such as turn taking, sharing, paying attention and following directions, etc. The preschool for the blind or visually impaired student must also provide the maximum opportunity for hands-on experiences. This exploration will aid in the development and acquisition of fine and gross motor skills, kinesthetic skills, and development of language appropriate to understanding for use in the everyday activities. Pragmatic language and activities that promote interdependence and interaction with their peers assure better outcomes for learning.

Collaboration with families, preschool teachers, teachers of the visually impaired, and any other related service is essential to provide meaningful experiences that promote early literacy and readiness for reading and writing in braille. The goal of the preschool programs is to meet each child's individual needs and to do so by establishing the collaboration between all stakeholders for the child.

## **How will the blind or visually impaired preschool child learn best?**

The learning environment is important for all children. To be successful, the child who is blind or visually impaired will need the following considerations:

- ❖ A learning environment that is organized, structured and predictable
- ❖ A learning environment that produces the correct light and placement of the child for learning
- ❖ A learning environment that emphasizes hands-on activities that promote exploration with the senses, real-life experiences, and interactions that nurture independence and relationships with peers
- ❖ A learning environment that is calm, free of visual and auditory clutter, and moves at a pace appropriate to the child's needs
- ❖ Immersion in a "braille-rich world," as sighted children are immersed in a "print-rich world," with braille labels on objects where incidental print is found, braille books on shelves, and braille labels on personal items

## **What kinds of learning opportunities will a child who is blind or visually impaired receive in a preschool?**

Learning opportunities for preschool children should be wide and varied. They should also be highly influenced by hands-on experiences such as:

- ❖ Use of "messy play" with things like water tables, sand boxes, art work and cooking activities.
- ❖ Physical activities, including climbing, swinging, running, jumping, using exercise equipment (large rubber balls, ropes, etc.).
- ❖ Having books that include things to touch, including braille books.
- ❖ Having children create their own stories, both real and pretend, that reflect their own experiences and chances to have these stories recorded for them, including in braille.
- ❖ Learn the vocabulary of books (e.g., top, bottom, front, back, pages, covers, title, and left to right), so that the children come to understand "how books work."
- ❖ Access to a braillewriter so that the students can "scribble" on it, much as sighted children "pretend to write."

- ❖ The opportunity, when they are ready, to learn tactile discrimination, braille letters, letter names, and sound-symbol relationships and to read lines of braille.

### **How should the preschool staff prepare for the child who is blind or visually impaired?**

The preschool staff where blind or visually impaired children are part of the class should:

- ❖ Receive information about normal development in blind children and monitor the children's concept acquisition frequently to ensure it is meaningful and accurate.
- ❖ Help sighted students interact appropriately with the blind or visually impaired children.
- ❖ Monitor blind or visually impaired children's listening attention and ensure the children have opportunities to listen to and understand stories, songs, and poetry, such as nursery rhymes.
- ❖ Recognize the importance of families' participation in early literacy experiences and encourage the student's families to read to them regularly.

### **What kind of access to the community is expected for preschoolers?**

Involvement with families and schools as a partnership will be a strength when entering into the broader community for experience and learning. Collaboration with the community will be essential. This includes the following:

- ❖ Opportunities for children and their families to meet and get to know competent braille readers, both older children and adults
- ❖ Opportunities for their families, friends, and general education teachers to learn the braille code, especially the braille alphabet, braille numbers and punctuation
- ❖ Opportunities to expose the children to braille in the community

## Challenges to Braille Instruction

Although challenges to braille instruction are expected, the following topics indicate the need for differentiated thinking about approaches to resolution of these challenges.

**Assessment of Students**—Driven by assessment, the decision to have a student learn braille should be informed by the assessment process. This should include the full spectrum of assessments available for the blind and visually impaired and individualized to each student’s need (i.e., students with low vision might learn to read print and braille simultaneously).

**Direct Instructional Time**—It has been found that teaching braille is “time-intensive,” and that the student should receive at least the same amount of time in direct instruction in braille literacy as their sighted peers receive reading instruction for print. Teaching the emergence of early literary skills in braille will also facilitate continuous feedback vital to success for early learners.

**Service Delivery Patterns**—Itinerant teachers tend to travel from school-to-school, serving students in their homes and in their schools. Itinerant teachers may then leave the student without direct instruction unless there is communication with other stakeholders, such as the classroom teacher, with knowledge about the braille code and teaching methodology for braille reading. The relationship between the itinerant teacher and the classroom teacher will strengthen the service delivery of students learning braille. Families also become an important part of the extended learning that takes place.

**Teacher Training**—Teachers of students who are blind or visually impaired need access to ongoing in-service training in the field of vision.

**Technology**—Currently there is a push to obtain assistive technology for students who are blind and visually impaired. Talking computer programs and other assistive devices are being designed to be implemented in classrooms. It is important to remember that access to information auditorily does not replace print

or braille. Braille translation software is not sufficient to ensure accurate braille production; therefore, the use of such software requires persons knowledgeable about the braille code.

**Age at Onset of Blindness**—For a variety of reasons, children become blind at different times in their lives. This creates a challenge for the teacher and the student as they figure out how to begin braille literacy at any age and any grade level.

**Differences in Methodologies**—There is an ongoing debate about the most successful way to impart braille reading instruction. This includes discussions about students with additional disabilities and learning needs. There is also research being done about when is the best time to introduce “uncontracted” braille to students. Uncontracted braille has no contractions. It does use the same symbols as are used in contracted braille to show capitalization, italics, numbers, and punctuation.

**Braille Production Standards**—The quality of Braille materials available varies widely. Access to certified transcribers varies widely as well. There must be a commitment to “dot-perfect” braille in our schools. Children who are blind or visually impaired deserve the same quality of materials as do print-reading children.

**Some Other Challenges to Consider:**

- It is recognized that literacy and reading skills are essential tools for all children. Braille is the tool that blind and visually impaired students use as a necessary basis for further learning.
- We must assure that students who are blind and visually impaired are afforded the same opportunity to learn language through Braille.
- Success depends upon the ability of a child to read and write, whether it in print or Braille.
- Because we live in a “visual” world, we must make the printed word readily available for all blind and visually impaired students.
- Audio materials and magnification devices have their place in the lives of some people who are functionally blind. However, just as the sighted

person has a pen and paper, the blind or visually impaired student needs to be taught the slate and stylus.

- Braille instruction is a necessary part of the education of a student who is blind or visually impaired.

# Elementary and Math Core Curriculum Definitions

1. "Basic skills course" means a subject which requires mastery of specific functions and was identified as a course to be assessed under Section 53A-1-602.
2. "Core Curriculum content standard" means a broad statement of what students enrolled in public schools are expected to know and be able to do at specific grade levels or following completion of identified courses.
3. "Core Curriculum Criterion-Referenced Test (CRT)" means a test to measure performance against a specific standard. The meaning of the scores is not tied to the performance of other students.
4. "Core Curriculum objective" means a more focused description of what students enrolled in public schools are expected to know and be able to do at the completion of instruction.
5. "Demonstrated competence" means subject mastery as determined by school district standards and review. School district review may include such methods and documentation as tests, interviews, peer evaluations, writing samples, reports or portfolios.
6. "Elementary school" for purposes of this rule means grades K-6 in whatever kind of school the grade levels exist.
7. "Individualized Education Program (IEP)" means a written statement for a student with a disability that is developed, reviewed, and revised in accordance with the Utah Special Education Rules and Part B of the Individuals with Disabilities Education Act (IDEA).
8. Nemeth Braille Code for Mathematics is a special type of braille used for math and science notation.
9. "Norm-referenced test" means a test where the scores are based on comparisons with a nationally representative group of students in the same grade. The meaning of the scores is tied specifically to student performance relative to the performance of the students in the norm group under very specific testing conditions.
10. "State Core Curriculum" means those standards of learning that are essential for all Utah students, as well as the ideas, concepts, and skills that provide a foundation on which subsequent learning may be built, as established by the Board.
11. The Board establishes minimum course description standards and objectives for each course in the required general core, which is commonly referred to as the Core Curriculum.

## **Reliance Upon Effective Assessment Practices**

- Student achievement of the standards and objectives in this core is best assessed using a variety of assessment instruments.
- Performance tests are particularly appropriate to evaluate student mastery of mathematical processes and problem-solving skills.
- Teachers should use a variety of classroom assessment approaches in conjunction with standard assessment instruments to inform instruction.
- Sample test items, keyed to each Core Standard, may be found on the “Utah Mathematics Home Page” at <http://www.usoe.k12.ut.us/curr/math>.
- Observation of students engaged in instructional activities is highly recommended as a way to assess students’ skills as well as attitudes toward learning. The nature of the questions posed by students provides important evidence of their understanding of mathematics.

## **The National Council of Teachers of Mathematics Curriculum Focal Points**

- In 2006, the National Council of Teachers of Mathematics (NCTM) published Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics (NCTM, 2006).
- This document is available online at <http://www.nctm.org/focalpoints>.
- This document describes three focal points for each grade level. NCTM’s focal points are areas of emphasis recommended for the curriculum of each grade level.
- The focal points within a grade are not the entire curriculum for that particular grade; however, Utah’s Core Curriculum was designed to include these areas of focus.

# Organization of the Elementary Mathematics Core

The core is designed to help teachers organize and deliver math instruction.

- Each grade level begins with a brief description of areas of instructional emphasis, which can serve as organizing structures for curriculum design and instruction.
- The INTENDED LEARNING OUTCOMES (ILOs) describe the skills and attitudes students should acquire as a result of successful mathematics instruction. They are found at the beginning of each grade level and are an integral part of the core.
- A STANDARD is a broad statement of what students are expected to understand. Several Objectives are listed under each Standard.
- An OBJECTIVE is a more focused description of what students need to know and be able to do at the completion of instruction. If students have mastered the Objectives associated with a given Standard, they have mastered that Standard at that grade level. Several Indicators are described for each Objective.
- INDICATORS are observable or measurable student actions that enable students to master an Objective. Indicators can help guide classroom instruction.
- MATHEMATICAL LANGUAGE AND SYMBOLS STUDENTS SHOULD USE includes language and symbols students should use in oral and written language.
- EXPLORATORY CONCEPTS AND SKILLS are included to establish connections with learning in subsequent grade levels. They are not intended to be assessed at the grade level indicated.

# **Utah Braille Core Standards**

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for Math K-6*

Kindergarten

# Kindergarten Math

By the end of kindergarten, students understand small numbers, quantities, and simple shapes in their everyday environment. They count, compare, describe and sort objects, and develop a sense of patterns. Students also develop an understanding of measurable attributes of objects.

## **Standard 1: Students will understand simple number concepts and relationships.**

**Objective 1:** Identify and use whole numbers up to 30.

- a. Represent whole numbers using concrete, pictorial, tactile, and symbolic representations.
- b. Order a set of up to ten objects and use ordinal numbers from first to tenth to identify the position of the object in the chosen order.
- c. Use one-to-one correspondence when counting a set of objects and develop a strategy for keeping track of counted and uncounted objects.

**Objective 2:** Identify and use simple relationships among whole numbers up to 30.

- a. Estimate quantities in a set of objects using multiples of 10 as benchmark numbers.
- b. Compose and decompose quantities to establish a relationship between the parts and the whole.
- c. Recognize 5 or 10 as a part of the part-whole relationship of numbers.
- d. Compare sets of objects and determine whether they have the same, fewer, or more objects.

**Objective 3:** Model, describe, and illustrate meanings of addition and subtraction for whole numbers less than ten.

- a. Demonstrate the joining and separating of sets of objects to solve problems.

- b. Describe the joining or separating of sets with informal language when using models.
- c. Record pictorially or describe the results from joining or separating of sets.

### **Mathematical Language and Symbols Students Should Use**

- add, subtract, first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, same, fewer, more

### **Exploratory Concepts and Skills**

- Count by ones, beginning from any number in the counting sequence.
- Represent quantities using concrete objects and investigate partitioning of sets.
- Create problems that can be solved using addition and subtraction.

### **Standard 2: Students will sort and classify objects as well as recognize and create simple patterns.**

**Objective 1:** Identify, sort, and classify objects according to common attributes.

- a. Sort objects into groups by attribute and identify which attribute was used.
- b. Describe multiple ways to sort and classify a group of objects including by color.
- c.

**Objective 2:** Identify, duplicate, describe, and extend simple repeating and growing patterns.

- a. Identify and describe simple repeating patterns with numbers and tactile shapes.
- b. Duplicate and extend simple repeating patterns with numbers and tactile shapes.
- c. Describe simple growing patterns with tactile shapes.
- d. Explore, locate, and identify simple patterns in the environment.

## **Mathematical Language and Symbols Students Should Use**

- sort, repeating patterns, growing patterns

## **Exploratory Concepts and Skills**

- Explore skip counting by fives, tens, and twos.

## **Standard 3: Students will understand basic geometry and measurement concepts as well as collect and organize data.**

**Objective 1:** Identify and create simple geometric shapes and describe simple spatial relationships.

- Identify, name, describe, and draw, create or form tactile sizes and orientations.
- Combine tactile shapes to create two-dimensional objects (e.g., using a triangle and square to create a picture of a house).
- Use words to describe position and distance.
- Investigate two- and three-dimensional objects and tactile shapes including hexagons, trapezoids, spheres, cubes, and cones.

**Objective 2:** Identify and use measurable attributes of objects and units of measurement.

- Identify braille clocks, talking clocks and braille calendars as tools that measure time.
- Identify a day, week, and month on a braille calendar and name the days of the week in order.
- Tactually identify authentic (genuine) pennies, nickels, dimes, and quarters as units of money.
- Compare two objects by measurable attributes (i.e., length, weight) and order several objects by measurable attributes (i.e., length, weight).

**Objective 3:** Collect and organize simple data.

- Pose questions and gather data about self and surroundings.

- b. Organize tactile or braille data obtained from sorting and classifying objects.

### **Mathematical Language and Symbols Students Should Use**

- circle, triangle, rectangle, square, Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, penny, nickel, dime, quarter, shorter, longer, above, below, near, far, between

### **Exploratory Concepts and Skills**

- Measure objects using non-standard units.
- Identify the value of a penny, nickel, dime, and quarter.
- Organize data in braille or tactile lists, tables, and simple graphs.

# **Utah Braille Core Standards**

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First Grade

# First Grade

By the end of grade one, students understand and use the concept of ones and tens in the base-ten number system. Students understand the meaning of addition and subtraction and add and subtract small numbers with ease. They measure with simple units and extend their understanding of geometric figures in their environment. They represent, describe, and interpret data and analyze and solve simple problems.

## **Standard 1: Students will acquire number sense and perform simple operations with whole numbers.**

**Objective 1:** Represent and use whole numbers up to 100.

- a. Count, read, braille whole numbers using appropriate braille math code.
- b. Represent whole numbers using the braille number line, models, and number sentences.
- c. Represent whole numbers greater than 10 in groups of tens and ones using objects, tactile pictures, and expanded notation.
- d. Using the Cranmer Abacus, set and read numbers from 1 to 100.

**Objective 2:** Identify simple relationships among whole numbers up to 100.

- a. Compare and order sets of objects and numbers using the terms *greater than*, *less than*, and *equal to* when describing the comparisons.
- b. Make reasonable estimates of the quantitative difference between two sets of objects.
- c. Identify one more, one less, 10 more, and 10 less than a given number.
- d. Identify numbers missing from a counting sequence.
- e. Represent part-whole relationships using the braille number line.

**Objective 3:** Model, describe, and illustrate the meanings of addition and subtraction, and use these operations to solve problems.

- a. Use a variety of models, including objects, length-based models, the braille number line, and the ten frame to describe problem types (i.e., part-whole, combine, separate, compare).
- b. Use the properties of addition (i.e., commutativity, associativity, identity element) and the mathematical relationship between addition and subtraction to solve problems.
- c. Compute basic addition facts (up to  $10 + 10$ ) and the related subtraction facts using strategies (e.g.,  $6 + 7 = (6 + 4) + 3 = 10 + 3 = 13$ ).
- d. Find the sum of three one-digit numbers.

### **Mathematical Language and Symbols Students Should Use**

- add, sum, subtract, difference, greater than, less than, equal to

### **Exploratory Concepts and Skills**

- Use concrete materials to investigate situations that lead to multiplication and division.
- Develop and use strategies for addition and subtraction of multi-digit whole numbers.
- Investigate the meaning of fraction concepts.
- Understand situations that entail multiplication and division, such as equal groupings of objects and sharing equally.

### **Standard 2: Students will identify and use number patterns and properties to describe and represent mathematical relationships.**

**Objective 1:** Recognize, describe, and represent patterns with more than one attribute.

- a. Sort and classify objects using more than one attribute.
- b. Identify, create, and label repeating patterns using objects, tactile pictures, and symbolic braille notation.
- c. Identify, create, and label growing patterns using objects, tactile pictures, and symbolic braille notation.
- d. Use patterns to establish skip counting by twos, fives, and tens.

**Objective 2:** Recognize and represent mathematical relationships using symbols and use number sentences with operational symbols to solve problems.

- a. Recognize that “=” in the appropriate braille math code indicates that the two sides of an equation are expressions of the same number.
- b. Recognize that “+” in the appropriate braille math code indicates the joining of sets and that “-” indicates the separation of sets.
- c. Using appropriate math code, braille write and solve number sentences from problem situations involving addition and subtraction, using symbolic notation for the missing value (e.g.,  $\cdot + 4 = 7$ ).
- d. Create problem situations from given number sentences involving addition and subtraction.

### **Mathematical Language and Braille Math Symbols Students Should Use**

- sort, attribute, repeating patterns, growing patterns, skip count, number sentence, symbol, +, -, =

### **Exploratory Concepts and Skills**

- Investigate situations with variables as unknowns and as quantities that vary.

**Standard 3: Students will understand simple geometry and measurement concepts as well as collect, represent, and draw conclusions from data.**

**Objective 1:** Identify, describe, and create simple geometric figures.

- a. Name, create, and sort tactile geometric plane figures (i.e., circle, triangle, rectangle, square, trapezoid, rhombus, parallelogram, hexagon).
- b. Tactually identify geometric plane and solid figures (i.e., circle, triangle, rectangle, square, trapezoid, hexagon, rhombus, parallelogram, cube, sphere, cone) in the students’ environment.

- c. Compose and decompose plane and solid figures (e.g., make two triangles from a square) and describe the part-whole relationships, the attributes of the figures, and how they are different and similar.

**Objective 2:** Identify measurable attributes of objects and units of measurement, and use appropriate techniques and tools to determine measurements.

- a. Identify the appropriate (braille and other) adaptive tools for measuring length, weight, capacity, temperature, and time.
- b. Measure the length of an object using nonstandard tactile units and count the units using groups of tens and ones.
- c. Using actual coins identify the value of a penny, nickel, dime, quarter, and dollar, and determine the value of a set of the same coins that total 25¢ or less (e.g., a set of 5 nickels equals 25¢).
- d. Tell time to the hour and half-hour.
- e. Name the months of the year and seasons in order, and use a braille calendar to determine the day of the week and date.

**Objective 3:** Collect, organize, and represent simple data.

- a. Collect and represent data using braille and tactile tables, tally marks, pictographs, and bar graphs.
- b. Describe and interpret data.

**Mathematical Language, Objects and Tactile Symbols Students Should Use**

- circle, triangle, rectangle, square, trapezoid, hexagon, rhombus, parallelogram, cube, sphere, cone, penny, nickel, dime, quarter, dollar, January, February, March, April, May, June, July, August, September, October, November, December, winter, spring, summer, fall, data, value, graph, tally mark

**Exploratory Concepts and Skills**

- Compare objects using non-standard units.
- Interpret data from charts and graphs.

# **Utah Braille Core Standards**

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Math K-6*

Second Grade

## Second Grade

By the end of grade two, students understand place value and number relationships in addition and subtraction, and they model simple concepts of multiplication and division. They measure quantities with appropriate units. They classify shapes and see relationships among them by paying attention to their geometric attributes. They collect and analyze data and verify the answers.

**Standard 1: Students will acquire number sense with whole numbers and fractions and perform operations with whole numbers.**

**Objective 1:** Identify and represent the relationships among numbers, quantities, and place value in whole numbers up to 1,000.

- a. Represent whole numbers in groups of hundreds, tens, and ones using base ten models and braille, using appropriate math code, the numeral representing the set in standard and expanded form.
- b. Identify the place and the value of a given digit in a three-digit brailled numeral.
- c. Represent the composition and decomposition of numbers in a variety of ways.
- d. Compare and order numbers using the terms *greater than*, *less than*, or *equal to*, and the appropriate Braille math code symbols,  $>$ ,  $<$ , and  $=$ , using various strategies, including the number line.
- e. Identify and describe even and odd whole numbers.
- f. Using the Cranmer Abacus set, read numbers up to 1,000. Name the place value of each of the first four columns of the abacus.

**Objective 2:** Use unit fractions to identify parts of the whole and parts of a set.

- a. Divide tactile geometric shapes into two, three, or four equal parts and identify the parts as halves, thirds, or fourths.

- b. Divide sets of objects into two, three, or four parts of equal number of objects and identify the parts as halves, thirds, or fourths.
- c. Represent the unit fractions  $1/2$ ,  $1/3$ , and  $1/4$  with objects, tactile diagrams, words (e.g., \_\_\_ out of \_\_\_ equal parts), and symbols.

**Objective 3:** Estimate, model, illustrate, describe, and solve problems involving two- and-three digit addition and subtraction.

- a. Demonstrate quick recall of addition facts (up to  $10 + 10$ ) and related subtraction facts.
- b. Model addition and subtraction of two- and three-digit whole numbers (sums and minuends to 1,000) in a variety of ways.
- c. Braille a story problem that relates to a given addition or subtraction equation, and write a number sentence to solve a story problem that is related to the environment.
- d. Demonstrate fluency with two- and three-digit addition and subtraction problems, using efficient, accurate, and generalizable strategies that include standard algorithms using the Cranmer Abacus and mental arithmetic, and describe why the procedures work.

**Objective 4:** Model, illustrate, and tactually record solutions to simple multiplication and division problems.

- a. Represent multiplication with equal groups using concrete objects and skip counting by twos, fives, and tens.
- b. Represent division as fair shares using concrete objects or tactile diagrams.

### **Mathematical Language and Appropriate Braille Math Code Symbols Students Should Use**

- number line, add, sum, subtract, difference, greater than, less than, equal to,  $>$ ,  $<$ ,  $=$ , even, odd, halves, thirds, fourths,  $1/2$ ,  $1/3$ ,  $1/4$

### **Exploratory Concepts and Skills**

- Investigate addition of common fractions (e.g.,  $1/2 + 1/2 = 1$ ,  $1/4 + 1/4 = 1/2$ ).
- Investigate comparing fractions in terms of greater than, less than, and equal to.

- Understand situations that entail multiplication and division, such as equal groupings of objects and sharing equally.

**Standard 2: Students will model, represent, and interpret patterns and number relationships to create and solve problems with addition and subtraction.**

**Objective 1:** Recognize, describe, create, and extend growing patterns.

- Determine the next term in linear patterns (e.g., 2, 4, 6...; the number of hands on one person, two people, three people).
- Construct tactile models and skip count by twos, threes, fives, and tens and relate to repeated addition.

**Objective 2:** Model, represent, and interpret number relationships using appropriate braille math code symbols.

- Recognize that “.” in braille indicates a relationship in which the two sides of the inequality are expressions of different numbers.
- Recognize that math braille symbols such as x, .., or .. in an addition or subtraction equation represent a number that will make the statement true.
- Use the commutative and associative properties of addition to simplify calculations.

**Mathematical Language and Appropriate Braille Math Code Symbols Students Should Use**

- patterns, +, -, =, .

**Exploratory Concepts and Skills**

- Investigate situations with variables as unknowns and as quantities that vary.

**Standard 3: Students will understand simple geometry and measurement concepts as well as collect, represent, and draw conclusions from data.**

**Objective 1:** Describe, classify, and create geometric figures.

- a. Describe and classify plane and solid geometric figures (i.e., circle, triangle, rectangle, square, trapezoid, rhombus, parallelogram, pentagon, hexagon, cube, sphere, cone) according to the number of sides and angles or faces, edges, and vertices.
- b. Compose and decompose shapes and tactile figures by substituting arrangements of smaller shapes for larger shapes or substituting larger shapes for arrangements of smaller shapes.
- c. Compose and decompose shapes and tactile figures and describe the part-whole relationships, similarities, and differences.

**Objective 2:** Identify and use units of measure, iterate (repeat) that unit, and compare the number of iterations to the item being measured.

- a. Identify and use tactile measurement units to measure, to the nearest unit, length (i.e., inch, centimeter), weight in pounds, and capacity in cups.
- b. Estimate and measure length by iterating a nonstandard or standard unit of measure using tactile measuring devices.
- c. With tactile measuring devices, use different units to measure the length of the same object and recognize that the smaller the unit, the more iterations needed to cover a given length.
- d. Determine the value of a set of up to five coins that total \$1.00 or less (e.g., three dimes, one nickel, and one penny equals 36¢).
- e. Tell time using tactile or talking clocks to the quarter-hour and sequence a series of daily events by time (e.g., breakfast at 7:00 a.m., school begins at 9:00 a.m, school ends at 3:00 p.m.).

**Objective 3:** Collect, record, organize, display, and interpret numerical data.

- a. Collect and tactually record data systematically, using a strategy for keeping track of what has been counted.
- b. Organize and represent the same data in more than one way.
- c. Organize, display, and label information visually and/or tactually, including keys, using pictographs, tallies, bar graphs, and organized tables.

- d. Describe data represented on tactile charts and graphs and answer simple questions related to data representations.

**Mathematical Language and Braille Symbols  
Students Should Use**

- inch, centimeter, pound, cup, circle, triangle, rectangle, square, trapezoid, rhombus, parallelogram, pentagon, hexagon, cube, sphere, cone, vertices, angle, face, edge, weight, length, capacity

**Exploratory Concepts and Skills**

- Use verbal instructions to move within the environment.
- Determine simple equivalencies of measurements.
- Conduct simple probability experiments.

# Intended Learning Outcomes for Third Through Sixth Grade Mathematics

The main intent of mathematics instruction is for students to value and use mathematics and reasoning skills to investigate and understand the world.

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should acquire as a result of successful mathematics instruction. They are an essential part of the Mathematics Core Curriculum and provide teachers with a standard for student learning in mathematics. Students using Braille need to acquire the same skills and attitudes as other students.

## ILOs for Mathematics

1. Develop a positive learning attitude toward mathematics.
2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
3. Reason logically, using inductive and deductive strategies and justify conclusions.
4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.
5. Represent mathematical ideas in a variety of ways, including using the appropriate braille math code.

Significant mathematics understanding occurs when teachers incorporate ILOs in planning mathematics instruction. Students using braille should not be given the impression that they are at a disadvantage, nor that learning math tactually using braille is more difficult than learning math visually for other students.

The following are ideas to consider when planning instruction for

students to acquire the ILOs:

1. Develop a positive learning attitude toward mathematics.

When students are confident in their mathematical abilities, they demonstrate persistence in completing tasks. They pose mathematical questions about objects, events, and processes while displaying a sense of curiosity about numbers and patterns. It is important to build on students' innate problem-solving inclinations and to preserve and encourage a disposition that values mathematics.

2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.

Mathematical knowledge is generated through problem solving as students explore mathematics. To become effective problem solvers, students need many opportunities to formulate questions and model problem situations in a variety of ways. They should generalize mathematical relationships and solve problems in both mathematical and everyday contexts.

Problem solving is the cornerstone of mathematics.

3. Reason logically, using inductive and deductive strategies and justify conclusions.

Mathematical reasoning develops in classrooms where students are encouraged to put forth their own ideas for examination. Students develop their reasoning skills by making and testing mathematical conjectures, drawing logical conclusions, and justifying their thinking in developmentally appropriate ways. Students use models, known facts, and relationships to explain reasoning. As they advance through the grades, students' arguments become more sophisticated.

4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and appropriate braille math code notation of mathematics.

The ability to express mathematical ideas coherently to peers, teachers, and others through oral and written language using the appropriate braille math code is an important skill in mathematics. Students develop this skill and deepen their understanding of mathematics when they use accurate mathematical language to talk and write about what they are doing. When students talk and write about mathematics, they clarify their ideas and learn how to make convincing arguments and represent mathematical ideas verbally, pictorially, and symbolically.

5. Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.

Students develop a perspective of the mathematics field as an integrated whole by understanding connections within mathematics. Students should be encouraged to explore the connections that exist with other disciplines and between mathematics and their own experiences.

6. Represent mathematical ideas in a variety of ways.

Mathematics involves using various types of representations, including concrete, pictorial, and symbolic models. In particular, identifying and locating braille numbers on the tactile number line has a central role in uniting all numbers to promote understanding of equivalent representations and ordering. Students also use a variety of mathematical representations to expand their capacity to think logically about mathematics.

7. Evaluate braille students' understanding of mathematics concepts.

Be certain students have mastered mathematical concepts and have not simply memorized procedures. Students should be able to explain concepts, transfer and generalize concepts.

# **Utah Braille Core Standards**

*Aligned with the Utah Core Curriculum  
Standards  
for Math K-6*

Third Grade

## Third Grade

By the end of grade three, students develop understandings of multiplication and division of whole numbers. They use properties to develop increasingly more sophisticated strategies to solve problems involving basic multiplication and division facts. They relate division to multiplication. Students understand fraction equivalence for simple fractions; they recognize that the size of a fractional part is relative to the size of the whole. They understand meanings of fractions to represent parts of a whole, parts of a set, or distances on a tactile number line. They compare and order simple fractions by using concrete or tactile models, benchmark fractions, or common denominators.

Students investigate, analyze, and classify two-dimensional shapes by their sides and angles. They decompose, combine, and transform polygons to understand properties of two-dimensional space and use those properties to solve problems. Using tactile graphics and appropriate braille math code, students construct and analyze frequency tables, bar graphs, picture graphs, and line plots and use them to solve problems.

**Standard 1: Students will understand the base-ten numeration system, place value concepts, simple fractions and perform operations with whole numbers.**

**Objective 1:** Represent whole numbers up to 10,000 using the Cranmer Abacus, comprehend place value concepts, and identify relationships among whole numbers using base-ten models and symbolic notation.

- a. Read, write, and represent whole numbers using standard and expanded form using appropriate braille math code.
- b. Demonstrate multiple ways to represent numbers using models and symbolic representations (e.g., fifty is the same as two groups of 25, the number of pennies in five dimes, or  $75 - 25$ ).
- c. Using appropriate braille math code and the Cranmer Abacus, identify the place and the value of a given digit in a four-digit

- numeral and round numbers to the nearest ten, hundred, and thousand.
- d. Order and compare whole numbers on a braille number line and use the appropriate braille math code symbols  $<$ ,  $>$ ,  $.$ , and  $=$  when comparing whole numbers.
  - e. Identify factors and multiples of whole numbers.

**Objective 2:** Use fractions to describe and compare parts of the whole.

- a. Identify the denominator of a fraction as the number of equal parts of the unit whole and the numerator of a fraction as the number of equal parts being considered.
- b. Define regions and sets of objects as a whole and divide the whole into equal parts using a variety of objects, models, and tactile illustrations.
- c. Name and write a fraction using appropriate braille math code to represent a portion of a unit whole for halves, thirds, fourths, sixths, and eighths.
- d. Place fractions on the braille number line and compare and order fractions using models, tactile illustrations, the braille number line, and appropriate braille math code symbols.
- e. Find equivalent fractions using concrete and tactile pictorial representations.

**Objective 3:** Model problems involving addition, subtraction, multiplication, and division.

- a. Demonstrate the meaning of multiplication and division of whole numbers through the use of a variety of representations (e.g., equal-sized groups, tactile arrays, area models, and equal jumps on a braille number line for multiplication, partitioning and sharing for division).
- b. Use a variety of strategies and tools, such as repeated addition or subtraction, equal jumps on the braille number line, and counters arranged in tactile arrays to model multiplication and division problems.
- c. Demonstrate, using objects, that multiplication and division by the same number are inverse operations (e.g.,  $3 \times . = 12$  is the same as  $12 \div 3 = .$  and  $. = 4$ ).
- d. Demonstrate the effect of place value when multiplying whole numbers by 10.

- e. Write a story problem that relates to a given addition, subtraction, or multiplication equation, and, using appropriate braille math code, write a number sentence to solve a problem related to the students' environment.

**Objective 4:** Compute and solve problems involving addition and subtraction of three- and four-digit numbers and basic facts of multiplication and division.

- a. Use a variety of methods to facilitate computation (e.g., estimation, mental math strategies, brailier).
- b. Find the sum or difference of numbers, including monetary amounts, using models and strategies such as expanded form, compensation, partial sums, and the standard algorithm using the Cranmer Abacus.
- c. Compute basic multiplication facts (0-10) and related division facts using a variety of strategies based on properties of addition and multiplication (i.e., commutative, associative, identity, zero, and the distributive properties).

### **Mathematical Language and Braille Math Code Symbols** **Students Should Use**

- sum, difference, expanded form, factor, product, array, multiple, numerator, denominator, halves, thirds, fourths, sixths, eighths, divisor, dividend, quotient, greater than, less than, equal to,  $<$ ,  $>$ ,  $=$

### **Exploratory Concepts and Skills**

- Extend multiplication and division to larger-digit numbers.
- Use concrete objects and tactile models to add and subtract common decimals.
- Investigate the distributive property of multiplication over addition for single-digit multipliers (e.g.,  $7 \times 15$  is equivalent to  $7 \times (10 + 5)$  is equivalent to  $(7 \times 10) + (7 \times 5)$ ).

**Standard 2: Students will use patterns, symbols, operations, and properties of addition and multiplication to represent and describe simple number relationships.**

**Objective 1:** Create, represent, and analyze growing patterns.

- a. Create and extend growing patterns using objects, numbers, and tables.
- b. Describe how patterns are extended using manipulatives, pictures, and numerical representations.

**Objective 2:** Recognize, represent, and simplify simple number relationships using symbols, operations, and properties.

- a. Represent numerical relationships as expressions, equations, and inequalities.
- b. Solve equations involving equivalent expressions (e.g.,  $6 + 4 = \cdot + 7$ ).
- c. Use the  $>$ ,  $<$ , and  $=$  symbols to compare two expressions involving addition and subtraction (e.g.,  $4 + 6 \cdot 3 + 2$ ;  $3 + 5 \cdot 16 - 9$ ).
- d. Recognize and use the commutative, associative, distributive, and identity properties of addition and multiplication, and the zero property of multiplication.

### **Mathematical Language and Symbols Students Should Use**

- growing patterns, expressions, equations,  $<$ ,  $>$ ,  $=$

### **Exploratory Concepts and Skills**

- Use concrete materials to build an understanding of equality and inequality.
- Explore properties of equality in number sentences (e.g., when equals are added to equals, then the sums are equal; when equals are multiplied by equals, then the products are equal).

### **Standard 3: Students will describe and analyze attributes of two-dimensional shapes.**

**Objective 1:** Describe and compare attributes of two-dimensional shapes.

- a. Identify, describe, and classify polygons (e.g., pentagons, hexagons, octagons).
- b. Identify attributes for classifying triangles (e.g., two equal sides for the isosceles triangle, three equal sides for the equilateral triangle, right angle for the right triangle).

- c. Identify attributes for classifying quadrilaterals (e.g., parallel sides for the parallelogram, right angles for the rectangle, equal sides and right angles for the square).
- d. Identify right angles in geometric figures, or in appropriate objects, and determine whether other angles are greater or less than a right angle.

**Objective 2:** Demonstrate the meaning of congruence through applying transformations.

- a. Demonstrate the effect of reflection, translation, or rotation using objects.
- b. Determine whether two polygons are congruent by reflecting, translating, or rotating one polygon to physically fit on top of the other.

### **Mathematical Language and Symbols Students Should Use**

- polygon, attribute, quadrilateral, equilateral triangle, isosceles triangle, right triangle, pentagon, hexagon, octagon, parallel, right angle, reflect, translate, rotate, slide, flip, turn, congruent

### **Exploratory Concepts and Skills**

- Explore line symmetry and rotational symmetry.
- Investigate two-dimensional representations of three-dimensional objects.

**Standard 4: Students will select and use appropriate units and measurement tools to solve problems.**

**Objective 1:** Select and use appropriate tools and units to estimate and measure length, weight, capacity, time, and perimeter of two-dimensional figures.

- a. Describe the part-whole relationships (e.g., 3 feet in a yard, a foot is  $\frac{1}{3}$  of a yard) between metric units of length (i.e., centimeter, meter), and among customary units of length (i.e., inch, foot, yard), capacity (i.e., cup, quart), and weight (i.e., pound, ounce).
- b. Measure the length of objects to the nearest centimeter, meter, half- and quarter-inch, foot, and yard.

- c. Measure capacity using cups and quarts, and measure weight using pounds and ounces.
- d. Identify the number of minutes in an hour, the number of hours in a day, the number of days in a year, and the number of weeks in a year.
- e. Describe perimeter as a measurable attribute of two-dimensional figures, and estimate and measure perimeter with metric and customary units.

**Objective 2:** Solve problems involving measurements.

- a. Determine simple equivalences of measurements (e.g., 30 inches = 2 feet and 6 inches; 6 cups = 1-1/2 quarts; 90 min. = 1 hr. 30 min.).
- b. Compare given objects according to measurable attributes (i.e., length, weight, capacity).
- c. Solve problems involving perimeter.
- d. Determine elapsed time in hours (e.g., 7:00 a.m. to 2:00 p.m.).

**Mathematical Language and Symbols Students Should Use**

- measure, unit, metric system, customary system, length, pound, ounce, centimeter, meter, inch, foot, yard, capacity, weight, perimeter

**Exploratory Concepts and Skills**

- Determine the value of a combination of coins and bills.
- Count back change from a single purchase.

**Standard 5: Students will collect and organize data to make predictions and identify basic concepts of probability.**

**Objective 1:** Collect, organize, and display data to make predictions.

- a. Collect, read, represent, and interpret data using tables, graphs, and charts, including keys (e.g., pictographs, bar graphs, frequency tables, line plots).
- b. Make predictions based on a data display.

**Objective 2:** Identify basic concepts of probability.

- a. Describe the results of events using the terms “certain,” “likely,” “unlikely,” and “impossible.”

- b. Conduct simple probability experiments, and record possible display results in an organized way (e.g., chart, graph).
- c. Use results of simple probability experiments to describe the likelihood of a specific outcome in the future.

**Mathematical Language and Symbols Students Should Use**

- data, table, chart, graph, frequency table, line plot, pictograph, bar graph, likely, certain, outcome, impossible outcome

**Exploratory Concepts and Skills**

- Predict outcomes of simple experiments.

# **Utah Braille Core Standards**

*Aligned with the Utah Core Curriculum  
Standards  
for Math K-6*

Fourth Grade

## Fourth Grade

By the end of grade four, students develop quick recall of the basic multiplication facts and related division facts. They develop fluency with efficient procedures for multiplying multi-digit whole numbers, understand why the procedures work, and use them to solve problems. Students recognize decimal notation as an extension of the base-ten system. They relate their understanding of fractions to decimals. They generate equivalent fractions, simplify fractions, and identify equivalent fractions and decimals; compare and order whole numbers, simple fractions, and decimals to hundredths; and estimate decimal or fractional amounts in problem solving.

Students use transformations, including those that produce line and rotational symmetry. Students understand area as a measurable attribute of two-dimensional regions. They select appropriate units, strategies, and tools for solving problems that involve measuring area. They connect area measure to the area model for multiplication as a way to justify the formula for the area of a rectangle.

### **Standard 1: Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.**

**Objective 1:** Demonstrate multiple ways to represent whole numbers and decimals, from hundredths to one million, and fractions.

- a. Read and write numbers in standard and expanded form.
- b. Demonstrate multiple ways to represent whole numbers and decimals by using models and symbolic representations (e.g., 36 is the same as the square of six, three dozen, or  $9 \times 4$ ).
- c. Identify the place and the value of a given digit in a six-digit numeral, including decimals to hundredths, and round to the nearest tenth.
- d. Divide regions, lengths, and sets of objects into equal parts using a variety of models and illustrations.
- e. Name and write a fraction to represent a portion of a unit whole, length, or set for halves, thirds, fourths, fifths, sixths, eighths, and tenths.

- f. Identify and represent square numbers using models and symbols.

**Objective 2:** Analyze relationships among whole numbers, commonly used fractions, and decimals to hundredths.

- a. Compare the relative size of numbers (e.g., 475 is comparable to 500; 475 is small compared to 10,000 but large compared to 98).
- b. Order whole numbers up to six digits, simple fractions, and decimals using a variety of methods (e.g., number line, fraction pieces) and use the symbols  $<$ ,  $>$ , and  $=$  to record the relationships.
- c. Identify a number that is between two given numbers (e.g., 3.2 is between 3 and 4; find a number between 0.1 and 0.2).
- d. Identify equivalences between fractions and decimals by connecting models to symbols.
- e. Generate equivalent fractions and simplify fractions using models, pictures, and symbols.

**Objective 3:** Model and illustrate meanings of multiplication and division of whole numbers and the addition and subtraction of fractions.

- a. Model multiplication (e.g., equal-sized groups, rectangular arrays, area models, equal intervals on the number line), place value, and properties of operations to represent multiplication of a one- or two-digit factor by a two-digit factor and connect the representation to an algorithm.
- b. Use rectangular arrays to interpret factoring (e.g., find all rectangular arrays of 36 tiles and relate the dimensions of the arrays to factors of 36).
- c. Demonstrate the mathematical relationship between multiplication and division (e.g.,  $3 \times \cdot = 12$  is the same as  $12 \div 3 = \cdot$  and  $\cdot = 4$ ) and use that relationship to explain that division by zero is not possible.
- d. Represent division of a three-digit dividend by a one-digit divisor, including whole number remainders, using a variety of methods (e.g., rectangular arrays, manipulatives, pictures), and connect the representation to an algorithm.

- e. Use models to add and subtract simple fractions where one single-digit denominator is 1, 2, or 3 times the other (e.g.,  $\frac{2}{4} + \frac{1}{4}$ ;  $\frac{3}{4} - \frac{1}{8}$ ).

**Objective 4:** Solve problems involving multiplication and division of whole numbers and addition and subtraction of simple fractions and decimals.

- a. Use estimation, mental math, paper and pencil, and calculators to perform mathematical calculations and identify when to use each one appropriately.
- b. Select appropriate methods to solve a single-operation problem and estimate computational results or calculate them directly, depending on the context and numbers involved in a problem.
- c. Write a story problem that relates to a given multiplication or division equation, and select and write a number sentence to solve a problem related to the environment.
- d. Solve problems involving simple fractions and interpret the meaning of the solution (e.g., “A pie has been divided into six pieces and one piece is already gone. How much of the whole pie is there when Mary comes in? If Mary takes two pieces, how much of the whole pie has she taken? How much of the pie is left?”).

**Objective 5:** Compute problems involving multiplication and division of whole numbers and addition and subtraction of simple fractions and decimals.

- a. Demonstrate quick recall of basic multiplication and division facts.
- b. Multiply up to a three- digit factor by a two-digit factor with fluency, using efficient procedures.
- c. Divide up to a three-digit dividend by a one-digit divisor with fluency, using efficient procedures.
- d. Add and subtract decimals and simple fractions where one single-digit denominator is 1, 2, or 3 times the other (e.g.,  $\frac{2}{4} + \frac{1}{4} = \frac{3}{4}$ ;  $\frac{1}{3} - \frac{1}{6} = \frac{1}{6}$ ).

**Mathematical Language and Symbols Students Should Use**

- sum, difference, expanded form, standard form, square number, dividend, divisor, quotient, factor, product, array,

multiple, numerator, denominator, sixths, eighths, tenths, equivalent, estimate,  $<$ ,  $>$ ,  $=$ ,  $.$

### **Exploratory Concepts and Skills**

- Use concrete objects and visual models to add and subtract common decimals.
- Explore numbers less than zero by extending the number line and by using familiar applications such as temperature.
- Investigate the concept of ratio (e.g., the number of students to the number of teachers).

### **Standard 2: Students will use patterns and relations to represent mathematical problems and number relationships.**

**Objective 1:** Identify, analyze, and determine rules for describing numerical patterns involving operations and nonnumerical growing patterns.

- a. Analyze growing patterns using objects, pictures, numbers, and tables to determine a rule for the pattern.
- b. Recognize, represent, and extend simple patterns involving multiples and other number patterns (e.g., square numbers) using objects, pictures, numbers, and tables.
- c. Identify simple relationships in real-life contexts and use mathematical operations to describe the pattern (e.g., the number of legs on a given number of chairs may be determined by counting by fours or by multiplying the number of chairs by four).

**Objective 2:** Use algebraic expressions, symbols, and properties of the operations to represent, simplify, and solve mathematical equations and inequalities.

- a. Use the order of operations to evaluate, simplify, and compare mathematical expressions involving the four operations, parentheses, and the symbols  $<$ ,  $>$ , and  $=$  (e.g.,  $2x(4 - 1) + 3$ ; of the two quantities  $7 - (3 - 2)$  or  $(7 - 3) - 2$ , which is greater?).
- b. Express single-operation problem situations as equations and solve the equation.

- c. Recognize that a symbol represents the same number throughout an equation or expression (e.g.,  $. + . = 8$ ; thus,  $. = 4$ ).
- d. Describe and use the commutative, associative, distributive, and identity properties of addition and multiplication, and the zero property of multiplication.

### **Mathematical Language and Symbols Students Should Use**

- growing pattern, order of operations, parentheses, inequality, expression, equation, associative property, commutative property, distributive property, zero property of multiplication,  $>$ ,  $<$ ,  $=$

### **Exploratory Concepts and Skills**

- Use concrete materials to build an understanding of equality and inequality.
- Explore properties of equality in number sentences (e.g., when equals are added to equals, then the sums are equal; when equals are multiplied by equals, then the products are equal).

## **Standard 3: Students will understand attributes and properties of plane geometric objects and spatial relationships.**

**Objective 1:** Identify and describe attributes of two-dimensional geometric shapes.

- a. Name and describe lines that are parallel, perpendicular, and intersecting.
- b. Identify and describe right, acute, obtuse, and straight angles.
- c. Identify and describe the radius and diameter of a circle.
- d. Identify and describe figures that have line symmetry and rotational symmetry.

**Objective 2:** Specify locations using grids and maps.

- a. Locate coordinates in the first quadrant of a coordinate grid.
- b. Give the coordinates in the first quadrant of a coordinate grid.
- c. Locate regions on a map of Utah.
- d. Give the regions of a position on a map of Utah.

**Objective 3:** Visualize and identify geometric shapes after applying transformations.

- a. Identify a translation, rotation, or a reflection of a geometric shape.
- b. Recognize that  $90^\circ$ ,  $180^\circ$ ,  $270^\circ$ , and  $360^\circ$  are associated, respectively, with  $1/4$ ,  $1/2$ ,  $3/4$ , and full turns.

### **Mathematical Language and Symbols Students Should Use**

- parallel, perpendicular, intersecting lines, right angle, acute angle, obtuse angle, straight angle, circle, radius, diameter, line symmetry, rotational symmetry, coordinate, first quadrant, degree, translate, rotate, reflect, transformation

### **Exploratory Concepts and Skills**

- Analyze results of transformations (e.g., translations, rotations, reflections) on two-dimensional shapes.
- Investigate two-dimensional representations of three-dimensional objects.

## **Standard 4: Students will describe relationships among units of measure, use appropriate measurement tools, and use formulas to find area measurements.**

**Objective 1:** Describe relationships among units of measure for length, capacity, and weight, and determine measurements of angles using appropriate tools.

- a. Describe the relative size among metric units of length (i.e., millimeter, centimeter, meter), between metric units of capacity (i.e., milliliter, liter), and between metric units of weight (i.e., gram, kilogram).
- b. Describe the relative size among customary units of capacity (i.e., cup, pint, quart, gallon).
- c. Estimate and measure capacity using milliliters, liters, cups, pints, quarts, and gallons, and measure weight using grams and kilograms.
- d. Recognize that angles are measured in degrees and develop benchmark angles (e.g.,  $45^\circ$ ,  $60^\circ$ ,  $120^\circ$ ) using  $90^\circ$  angles to estimate angle measurement.
- e. Measure angles using a protractor or angle ruler.

**Objective 2:** Recognize and describe area as a measurable attribute of two-dimensional shapes and calculate area measurements.

- a. Quantify area by finding the total number of same-sized units of area needed to fill the region without gaps or overlaps.
- b. Recognize that a square that is one unit on a side is the standard unit for measuring area.
- c. Develop the area formula for a rectangle and connect it with the area model for multiplication.
- d. Develop and use the area formula for a right triangle by comparing with the formula for a rectangle (e.g., two of the same right triangles makes a rectangle).
- e. Develop, use, and justify the relationships among area formulas of triangles and parallelograms by decomposing and comparing with areas of right triangles and rectangles.
- f. Determine possible perimeters, in whole units, for a rectangle with a fixed area, and determine possible areas when given a rectangle with a fixed perimeter.

### **Mathematical Language and Symbols Students Should Use**

- Millimeter, centimeter, meter, milliliter, liter, gram, kilogram, cup, pint, quart, gallon, area, perimeter

### **Exploratory Concepts and Skills**

- Investigate perimeter of rectangles and squares.
- Investigate area of trapezoids.

### **Standard 5: Students will interpret and organize collected data to make predictions, answer questions, and describe basic concepts of probability.**

**Objective 1:** Collect, organize, and display data to answer questions.

- a. Identify a question that can be answered by collecting data.
- b. Collect, read, and interpret data from tables, graphs, charts, surveys, and observations.
- c. Represent data using frequency tables, bar graphs, line plots, and stem and leaf plots.
- d. Identify and distinguish between clusters and outliers of a data set.

**Objective 2:** Describe and predict simple random outcomes.

- a. Describe the results of experiments involving random outcomes as simple ratios (e.g., 4 out of 9,  $\frac{4}{9}$ ).
- b. Conduct simple probability experiments, with and without replacement, record possible outcomes systematically, and display results in an organized way.
- c. Use the results of simple probability experiments, with and without replacement, to describe the likelihood of a specific outcome in the future.

**Mathematical Language and Braille or Tactile Symbols Students Should Use**

- data, line plot, line graph, bar graph, stem and leaf plot, cluster, outlier, frequency table, probability

**Exploratory Concepts and Skills**

- Explore minimum and maximum values for a set of data.
- Explore mean, median, mode, and range.

# **Utah Braille Core Standards**

*Aligned with the Utah Core Curriculum  
Standards  
for Math K-6*

Fifth Grade

# Fifth Grade

By the end of grade five, students increase their facility with the four basic arithmetic operations applied to whole numbers, fractions, and decimals. They locate integers on a number line and ordered pairs of integers on the coordinate plane. They determine rules for numerical patterns, work with expressions including order of operations, and solve single-operation equations involving a single variable. They classify angles, triangles, and quadrilaterals, and analyze relationships among lines, triangles and quadrilaterals. They recognize and determine surface area and volume of three-dimensional shapes, including right prisms. Students understand the concepts of mean, median, mode, and range of data sets and can calculate them. They use line plots, bar graphs, and line graphs to record and analyze data.

**Standard 1: Students will expand number sense to include integers and perform operations with whole numbers, simple fractions, and decimals.**

**Objective 1:** Represent whole numbers and decimals from thousandths to one billion, fractions, percents, and integers.

- a. Read and write numbers in standard and expanded form.
- b. Demonstrate multiple ways to represent whole numbers, decimals, fractions, percents, and integers using models and symbolic representations (e.g.,  $108 = 2 \times 50 + 8$ ;  $108 = 102 + 8$ ;  $90\% = 90$  out of 100 squares on a hundred chart).
- c. Identify, read, and locate fractions, mixed numbers, decimals, and integers on the number line.
- d. Represent repeated factors using exponents.
- e. Describe situations where integers could be used in the students' environment.

**Objective 2:** Explain relationships and equivalencies among integers, fractions, decimals, and percents.

- a. Compare fractions by finding a common denominator.
- b. Order integers, fractions (including mixed numbers), and decimals using a variety of methods, including the number line.

- c. Rewrite mixed numbers and improper fractions from one form to the other and represent each using regions, sets of objects, or line segments.
- d. . Represent commonly used fractions as decimals and percents in a variety of ways (e.g., models, fraction strips, pictures, calculators, algorithms).
- e. Model and calculate equivalent forms of a fraction (including simplest form).
- f. Rename whole numbers as fractions with different denominators (e.g.,  $5 = 5/1$ ,  $3 = 6/2$ ,  $1 = 7/7$ ).

**Objective 3:** Use number theory concepts to develop and use divisibility tests; classify whole numbers to 50 as prime, composite, or neither; and find common multiples and factors.

- a. Identify patterns with skip counting and multiples to develop and use divisibility tests for determining whether a whole number is divisible by 2, 3, 5, 6, 9, and 10.
- b. Use strategies for classifying whole numbers to 50 as prime, composite, or neither.
- c. Rewrite a composite number between 2 and 50 as a product of only prime numbers.
- d. Find common multiples and factors and apply to adding and subtracting fractions.

**Objective 4:** Model and illustrate meanings of multiplication and division.

- a. Represent division-with-remainder using whole numbers, decimals, or fractions.
- b. Describe the effect of place value when multiplying and dividing whole numbers and decimals by 10, 100, and 1,000.
- c. Model multiplication of fractions and decimals (e.g., tenths multiplied by tenths, a whole number multiplied by tenths, or a whole number with tenths multiplied by tenths) in a variety of ways (e.g., manipulatives, number line and area models, patterns).

**Objective 5:** Solve problems involving one or two operations.

- a. Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, and algorithms.

- b. Make reasonable estimations of fraction and decimal sums, differences, and products, including knowing whether results obtained using a calculator are reasonable.
- c. Write number sentences that can be used to solve a two-step problem.
- d. Interpret division-with-remainder problems as they apply to the environment (e.g., If there are 53 people, how many vans are needed if each van holds 8 people?).

**Objective 6:** Demonstrate proficiency with multiplication and division of whole numbers and compute problems involving addition, subtraction, and multiplication of decimals and fractions.

- a. Multiply multi-digit whole numbers by a two-digit whole number with fluency, using efficient procedures.
- b. Divide multi-digit dividends by a one-digit divisor with fluency, using efficient procedures.
- c. Add and subtract decimals with fluency, using efficient procedures.
- d. Add and subtract fractions with fluency.
- e. Multiply fractions.

### **Mathematical Language and Symbols Students Should Use**

- prime, composite, exponent, fractions, numerator, denominator, common denominator, common factor, common multiple, decimals, percents, divisible, divisibility, equivalent fractions, integer, dividend, quotient, divisor, factor, order of operations, simplest terms, various symbols for multiplication and division, mixed numeral, improper fraction

### **Exploratory Concepts and Skills**

- Extend classification of whole numbers from 0-100 as prime, composite, or neither.
- Apply rules of divisibility.
- Explore adding and subtracting integers.
- Divide multi-digit dividends by a two-digit divisor.

**Standard 2: Students will use patterns and relations to represent and analyze mathematical problems and number relationships using algebraic symbols in appropriate braille math code.**

**Objective 1:** Identify, analyze and determine a rule for predicting and extending numerical patterns involving operations whole numbers, decimals, and fractions.

- a. Analyze and make predictions about numeric patterns, including decimals and fractions.
- b. Determine a rule for the pattern using organized braille lists, braille tables, objects, and variables.

**Objective 2:** Use brailled algebraic expressions, inequalities, or equations to represent and solve simple real-world problems.

- a. Use properties and the order of operations involving addition, subtraction, multiplication, division, and the use of parentheses to compute with whole numbers, decimals, and fractions.
- b. Use patterns, models, and relationships as contexts for writing and solving simple equations and inequalities with whole number solutions (e.g.,  $6x = 54$ ;  $x + 3 = 7$ ).

### **Mathematical Language and Braille or Tactile Symbols Students Should Use**

- Variety of symbols for multiplication and division such as  $\times$ ,  $\cdot$ , and  $*$  as symbols for multiplication and  $\div$ ,  $\epsilon$ , and a fraction bar ( $/$  or  $—$ ) as division symbols; variable, order of operations, parentheses, inequality, expression, equation, associative property, commutative property, distributive property

### **Exploratory Concepts and Skills**

- Solve multi-step equations.
- Construct and analyze tables involving equivalent ratios.

### **Standard 3: Students will use spatial reasoning to recognize, describe, and analyze geometric shapes and principles.**

**Objective 1:** Describe relationships between two- and three-dimensional shapes and analyze attributes and properties of geometric shapes.

- a. Tactually draw, label, and describe line segments, rays, lines, parallel lines, and perpendicular lines.

- b. Tactually draw, label, and define an angle as two rays sharing a common endpoint (vertex).
- c. Classify tactile triangles and quadrilaterals and analyze the relationships among the shapes in each classification (e.g., a square is a rectangle).
- d. Relate pyramids and right prisms to the two-dimensional shapes (nets) from which they were created.
- e. Identify properties and attributes of solids both models and tactile representations (i.e., right prisms, pyramids, cylinders, cones) and describe them by the number of edges, faces, and vertices as well as the types of faces.

**Objective 2:** Specify locations in a coordinate plane.

- a. Locate points on a tactile graph defined by ordered pairs of integers.
- b. Braille an ordered pair for a point in a tactile coordinate plane with integer coordinates.
- c. Specify possible paths between locations on a tactile coordinate plane and compare distances of the various paths.

### **Mathematical Language and Braille or Tactile Symbols Students Should Use**

- perpendicular and parallel lines, rays, angles (acute, obtuse, right, straight), triangles (equilateral, isosceles, scalene, right, acute, obtuse), vertex, vertices, edge, face, corresponding angles, similar, polygon, pyramid, right prism

### **Exploratory Concepts and Skills**

- Compare corresponding angles of two tactile triangles and determine whether the triangles are similar.
- Rotate a tactile shape around a fixed point and identify the location of the new vertices.
- Translate a tactile polygon either horizontally or vertically on a coordinate grid and identify the location of the new vertices.

- Reflect a tactile shape across either the x- or y-axis and identify the location of the new vertices.

**Standard 4: Students will determine area of polygons and surface area and volume of three-dimensional shapes.**

**Objective 1:** Determine the area of polygons and apply to real-world problems.

- Determine the area of a tactile trapezoid by the composition and decomposition of rectangles, triangles, and parallelograms.
- Determine the area of irregular and regular tactile polygons by the composition and decomposition of rectangles, triangles, and parallelograms.
- Compare areas of tactile polygons using different units of measure within the same measurement system (e.g., square feet, square yards).

**Objective 2:** Recognize, describe, and determine surface area and volume of three-dimensional shapes.

- Quantify volume by finding the total number of same-sized units of volume needed to fill the space without gaps or overlaps.
- Recognize that a cube having a one-unit edge is the standard unit for measuring volume expressed as a cubic unit.
- Derive and use the formula to determine the volume of a right prism with a triangular or rectangular base.
- Relate the formulas for the areas of triangles, rectangles, or parallelograms to the surface area of a right prism.
- Derive and use the formula to determine the surface area of a right prism and express surface area in square units.

**Mathematical Language and Braille or Tactile Symbols Students Should Use**

- area, volume, surface area, volume, right prism

### **Exploratory Concepts and Skills**

- Investigate pi as the ratio of the circumference to the diameter of a circle.
- Determine the volume of a right prism with various bases.

### **Standard 5: Students will construct, analyze, and construct reasonable conclusions from data and apply basic concepts of probability.**

**Objective 1:** Formulate and answer questions using statistical methods to compare data, and propose and justify inferences based on data.

- Construct, analyze, and display data using an appropriate format (e.g. tactile, line plots, bar graphs, line graphs).
- Recognize the differences in representing categorical and numerical data.
- Identify minimum and maximum values for a set of brailled data.
- Identify and calculate the mean, median, mode, and range.

**Objective 2:** Apply basic concepts of probability.

- Describe the results of experiments involving random outcomes using a variety of notations (e.g., 4 out of 9, 4/9).
- Recognize that probability is always a value between 0 and 1 (inclusively).
- Express the likelihood of an outcome in a simple experiment as a value between 0 and 1 (inclusively).

### **Mathematical Language and Braille or Tactile Symbols Students Should Use**

- data, minimum values, maximum values, mean, median, mode, average, range

### **Exploratory Concepts and Skills**

- Explore the differences in representing categorical and numerical data.

# **Utah Braille Core Standards**

*Aligned with the Utah Core Curriculum  
Standards  
for Math K-6*

Sixth Grade

# Sixth Grade

By the end of grade six, students have mastered the four arithmetic operations with whole numbers, positive rational numbers, positive decimals, and positive and negative integers; they accurately compute and solve problems. They find prime factorizations, least common multiples, and greatest common factors. They create, evaluate, and simplify expressions, and solve equations involving two operations and a single variable. They solve problems involving an unknown angle in a triangle or quadrilateral, and use properties of complementary and supplementary angles. Students know about  $\pi$  as the ratio between the circumference and the diameter of a circle and solve problems using the formulas for the circumference and area of a circle. Students analyze, draw conclusions, and make predictions based upon data and apply basic concepts of probability.

## **Standard 1: Students will expand number sense to include operations with rational numbers.**

**Objective 1:** Represent rational numbers in a variety of ways.

- a. Recognize a rational number as a ratio of two integers,  $a$  to  $b$ , where  $b$  is not equal to zero.
- b. Change whole numbers with exponents to standard form (e.g.,  $2^4 = 16$ ) and recognize that any non-zero whole number to the zero power equals 1 (e.g.,  $90^0 = 1$ ).
- c. Using appropriate math code braille a whole number in expanded form using exponents (e.g.,  $876,539 = 8 \times 10^5 + 7 \times 10^4 + 6 \times 10^3 + 5 \times 10^2 + 3 \times 10^1 + 9 \times 10^0$ ).
- d. Express numbers in scientific notation using positive powers of ten using appropriate braille math code.

**Objective 2:** Explain relationships and equivalencies among rational numbers.

- a. Place rational numbers on the braille number line.
- b. Compare and order rational numbers, including positive and negative mixed fractions and decimals, using a variety of methods and braille symbols, including the braille number line and finding common denominators.

- c. Find equivalent forms for common fractions, decimals, percents, and ratios, including repeating or terminating decimals.
- d. Relate percents less than 1% or greater than 100% to equivalent fractions, decimals, whole numbers, and mixed numbers.
- e. Recognize that the sum of an integer and its additive inverse is zero.

**Objective 3:** Use number theory concepts to find prime factorizations, least common multiples, and greatest common factors.

- a. Determine whether whole numbers to 100 are prime, composite, or neither.
- b. Find the prime factorization of composite numbers to 100.
- c. Find the greatest common factor and least common multiple for two numbers using a variety of methods (e.g., list of multiples, prime factorization).

**Objective 4:** Model and illustrate meanings of operations and describe how they relate.

- a. Relate fractions to multiplication and division and use this relationship to explain procedures for multiplying and dividing fractions.
- b. Recognize that ratios derive from pairs of rows in the braille multiplication table and connect with equivalent fractions.
- c. Give mixed number and decimal solutions to division problems with whole numbers.

**Objective 5:** Solve problems involving multiple steps.

- a. Select appropriate methods to solve a multi-step problem involving multiplication and division of fractions and decimals.
- b. Use estimation to determine whether results obtained using a talking calculator are reasonable.
- c. Use estimation or calculation to compute results, depending on the context and numbers involved in the problem.
- d. Solve problems involving ratios and proportions.

**Objective 6:** Demonstrate proficiency with the four operations, with positive rational numbers, and with addition and subtraction of integers.

- a. Multiply and divide a multi-digit number by a two-digit number, including decimals using the Cranmer Abacus.
- b. Add, subtract, multiply, and divide fractions and mixed numbers using the Cranmer Abacas as needed.
- c. Add and subtract integers.

### **Mathematical Language and Braille or Tactile Symbols Students Should Use**

- prime, composite, exponent, least common multiple, least common denominator, greatest common factor, decimals, percents, divisible, divisibility, equivalent fractions, integer, dividend, quotient, divisor, factor, simplest terms, mixed numeral, improper fraction

### **Exploratory Concepts and Skills**

- Explore the addition and subtraction of positive and negative fractions.
- Investigate the concepts of ratio and proportion.
- Investigate the distributive property of multiplication over addition of double-digit multipliers.

### **Standard 2: Students will use patterns, relations, and algebraic expressions in braille to represent and analyze mathematical problems and number relationships.**

**Objective 1:** Analyze algebraic expressions in braille, braille tables, and tactile graphs to determine patterns, relations, and rules.

- a. Describe simple relationships by creating and analyzing braille tables, equations, and expressions.
- b. Create a tactile graph and using appropriate math code braille an equation from a braille table of values.
- c. Create a tactile graph and create a table of values from an equation.

**Objective 2:** Braille, interpret, and use mathematical expressions, equations, and formulas to represent and solve problems that correspond to given situations.

- a. Solve single variable linear brailled equations using a variety of strategies.

- b. Recognize that expressions in different forms can be equivalent and rewrite an expression to represent a quantity in a different way.
- c. Evaluate and simplify brailled expressions and formulas, substituting given values for the variables (e.g.,  $2x + 4$ ;  $x = 2$ ; therefore,  $2(2) + 4 = 8$ ).

### **Mathematical Language and Braille or Tactile Symbols Students Should Use**

- order of operations, sequence, function, pattern, algebraic expression, approximately equal,  $\approx$ , notation for exponents:  $4^3$  or  $4^3$ , a number in front of a variable indicates multiplication (e.g.,  $3y$  means 3 times the quantity  $y$ ), formula, generalization

### **Exploratory Concepts and Skills**

- Use physical models to investigate and describe how a change in one variable affects a second variable.
- Use models to develop understanding of slope as constant rate of change.
- Model situations with proportional relationships and solve problems.

### **Standard 3: Students will use spatial and logical reasoning to recognize, describe, and analyze tactile geometric shapes and principles.**

**Objective 1:** Identify and analyze attributes and properties of tactile geometric shapes to solve problems.

- a) Using tactile drawings or models identify the midpoint of a line segment and the center and circumference of a circle.
- b) Using tactile drawings or models identify angles as vertical, adjacent, complementary, or supplementary and provide descriptions of these terms.
- c) Develop and use the properties of complementary and supplementary angles and the sum of the angles of a triangle to solve problems involving an unknown angle in a triangle or quadrilateral.

**Objective 2:** Visualize and identify tactile geometric shapes after applying transformations on a braille coordinate plane.

- a. Rotate a tactile polygon about the origin by a multiple of  $90^\circ$  and identify the location of the new vertices.
- b. Translate a tactile polygon either horizontally or vertically on a raised line coordinate grid and identify the location of the new vertices.
- c. Reflect a tactile polygon across either the x- or y-axis and identify the location of the new vertices.

### **Mathematical Language and Braille or Tactile Symbols Students Should Use**

- midpoint, circumference, complementary and supplementary angles, rotate, translate, reflect, transformation

### **Exploratory Concepts and Skills**

- Use manipulatives and technology to model geometric shapes.
- Investigate tessellations.
- Explore the angles formed by intersecting raised lines.
- Identify and create tactile shapes and figures from different views/perspectives.

### **Standard 4: Students will understand and apply measurement tools and techniques and find the circumference and area of a tactile circle.**

#### **Objective 1:** Describe and find the circumference and area of a tactile circle.

- a. Explore the relationship between the radius and diameter of a tactile circle to the circle's circumference to develop the formula for circumference.
- b. Find the circumference of a tactile circle using a formula.
- c. Describe pi as the ratio of the circumference to the diameter of a circle.
- d. Decompose a circle model into a number of wedges and rearrange the wedges into a shape that approximates a parallelogram to develop the formula for the area of a circle.
- e. Find the area of a circle using a formula.

#### **Objective 2:** Identify and describe measurable attributes of objects and units of measurement, and solve problems involving measurement.

- a. Recognize that measurements are approximations and describe how the size of the unit used in measuring affects the precision.
- b. Convert units of measurement within the metric system and convert units of measurement within the customary system.
- c. Compare a meter to a yard, a liter to a quart, and a kilometer to a mile.
- d. Determine when it is appropriate to estimate or use precise measurement when solving problems.
- e. Derive and use the formula to determine the surface area and volume of a cylinder.

**Mathematical Language and Braille or Tactile Symbols Students Should Use**

- cylinder, radius, diameter, circumference, area, surface area, volume

**Exploratory Concepts and Skills**

- Investigate volumes and surface areas of a variety of three-dimensional objects.

**Standard 5: Students will analyze, draw conclusions, and make predictions based upon tactile or braille data and apply basic concepts of probability.**

**Objective 1:** Design investigations to reach conclusions using statistical methods to make inferences based on data.

- a. Design investigations to answer questions.
- b. Extend data display and comparisons to include braille scatter plots and circle graphs.
- c. Compare two similar sets of data on the same tactile graph and compare two tactile graphs representing the same set of data.
- d. Recognize that changing the scale influences the appearance of a display of data.
- e. Propose and justify inferences and predictions based on data.

**Objective 2:** Apply basic concepts of probability and justify outcomes.

- a. Braille the results of a probability experiment as a fraction between zero and one, or an equivalent percent.
- b. Compare experimental results with theoretical results (e.g., experimental: 7 out of 10 tails; whereas, theoretical 5 out of 10 tails).
- c. Compare individual, small group, and large group results of a probability experiment in order to more accurately estimate the actual probabilities.

**Mathematical Language and Braille or Tactile Symbols Students Should Use**

- data display, scatter plot, circle graph, scale, predict, justify, probability, experimental results, theoretical results

**Exploratory Concepts and Skills**

- Investigate the notion of fairness in games.

# Appendix A

## Prerequisite Braille Note-Taker Skills

- Ability to write with a Perkins braille.
- Ability to use adequate keyboard touch skills with a light touch and accurate finger placement.
- Completion of a braille readiness program.
- Basic knowledge of braille alphabet.
- Ability to produce contracted braille.
- Ability to follow at least two-step directions.
- Knowledge of basic computer commands.
- Knowledge of basic computer file management.
- Ability to take care of and be responsible for equipment.

## References

Braille Reading Standards Adopted by the California Board of Education, California Department of Education, 2006.

Utah Core Curriculum, Teaching and Learning Section, Utah State Office of Education, 2010-2011.

The optimum expectation is that our students will be successful in school and in life. Teachers should be confident and competent themselves in using braille. It is hoped that our teachers will be adequately and appropriately prepared to teach the Nemeth Braille Math Code.

