

MathBuilders

Measurement



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MathBuilders

Measurement

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Introduction

Measurement provides one of the most frequent needs for numbers in our everyday lives. It is not uncommon to hear people speak about the number of miles between two locations or the number of days until a specific event. Young children can be found discussing the number of brothers and/or sisters they have or the number of cookies they found in their lunch. We would be lost in a world where numbers could not give us a better understanding of such things as time, air temperature, weight, blood pressure, etc. Measurement is a critical part of our world; yet, the teaching of measurement in the elementary school presents some of the most frustrating mathematical experiences for both the student and teacher.


Measurement must be a part of the early elementary mathematics curriculum. It is too important to be postponed or omitted at any grade level. In the early elementary years, time focused on measurement should include activities to enable a student to understand the attributes of length, capacity, weight, area, volume, time, and temperature. Also, measurement activities should develop the actual process of measuring and concepts related to units of measure. Likewise,



measurement activities should include problem solving and real world situations as well as estimation of measurements.

Simply stated, measurement is the process of assigning a number to a physical property of an object or set of objects, usually for the purpose of comparison. While not all measurement is geometric, measurement is actually an essential part of geometry.

There are two types of measurement. The first type involves the use of discrete variables. This deals with things that can be counted. Children learn at a very early age to use numbers to show how many things are in a set of discrete objects (e.g., “There are five teddy bears on my bed.” or “I have four coats in my closet.”). When students count discrete objects, such as marbles or apples, they are attempting to determine or measure a total. A person’s height or weight cannot be determined in this manner though. This type of measurement involves the use of continuous variables, such as height, weight, time, and temperature. Continuous variables can be represented on an uninterrupted scale. A system of assigning numbers to discrete objects often can motivate a child to use a similar scheme to express the magnitude of continuous quantities. It




may be helpful to think of something continuous as being made up of small, equal sized discrete parts (or units) that can be put together to reconstruct the original quantity.

The mathematics of measurement includes a variety of basic ideas that may be quite obvious to an adult, yet need to be developed and taught to a child. The young elementary student encounters or applies these ideas in an informal and intuitive way, with the generalizations and verbalizations not occurring until later grades.


There are several foundational ideas that are at the core of these measurement activities. Length will be used throughout these idea statements, but it should be noted that they can be generalized to other measurement topics.

- Exactly one number is assigned by counting to describe the length of a segment. Rather than counting repeatedly, we develop and read scales or calibrated instruments that do the counting for us.
- A line segment, or linear object, can be assigned a length of 1. This makes possible the design of a measuring instrument for length or a ruler.

- 
- Length can be treated as a number; thus we can add segments like we add numbers. A young child may not realize that transformation will change the length of an object and will leave it the same.
 - Iteration, the repeated application of a unit, allows one to use a number line and a ruler to find the distance between two points on a segment.
 - Transitivity allows us to compare segments. For example, we know that if Steve is taller than Sadie, and Sadie is taller than Ruth, then Steve is taller than Ruth.


Likewise, the following general principles of instruction were focused upon when designing the measurement component of this mathematics curriculum.

- Young students must measure frequently and often, preferably on real world problems rather than textbook exercises.
- Young students should encounter activity oriented measurement situations by doing and experimenting rather than passively observing. The activities should encourage discussion to stimulate the refinement and testing of ideas and concepts.

- 
- Instructional planning must emphasize the important ideas of measurement that transfer or work across measurement systems.

When the teacher decides that the students are ready to investigate measurement concepts and skills, another component must be considered. Many young children may see no need to learn these ideas. Measurement tasks may not be, in any way, a part of their out-of-school experience. As far as they are concerned, the use of the word “big” may suffice when comparisons are to be made. An early elementary teacher will find advantages to basing his/her teaching on the assumption that time will be needed to get his/her students to see the need for learning measurement skills and ideas. It should be noted here that it is inappropriate to suggest to young students that one system of measurement is easier to learn or more natural to use than another. Years of experience may contribute to the false notion that one system or one set of units is somehow natural, whereas another system is difficult. The process of learning how to measure is the same in any system.


What follows are the main ideas of a sequence used in this unit for teaching measurement to



young children, summarized by identifying the important concepts and skills for the measurement of length.

- Develop terms to describe the characteristics of length using sorting tasks.
- Use appropriate terminology while making comparisons and ordering using three or more objects.
- Find answers to “How long?”
 - select an arbitrary unit
 - place units appropriately
 - measure to the nearest unit
 - estimate using the units
 - design a measurement instrument (ruler)
 - interpret the markings and numbers on the ruler
 - recognize the need for standard units
 - become familiar with standard units
 - estimate using standard units
- Solve problems with standard units.
- Use the relationship among different units.

The teaching and learning of measurement requires explanations, activities, and tasks that cannot be easily represented on a textbook




page. Activities must involve actual object comparison and discussion must include appropriate terminology. Using correct language is a very important learning outcome. For young elementary students, measurement may seem to be a contrived process, and due to its complexity, students need multiple exposures.

The teacher is the key in the teaching-learning process of measurement. Printed materials can certainly be a valuable reference, but it is the teacher who determines whether the topic, the teaching sequence, and the activities are appropriate for a given age level or for a certain classroom setting. The activities here are related to learning how to measure and done without the use of a textbook.

Finally, the overall aim of this unit is to develop in young elementary school students an inner conviction that those activities which we refer to as measurement are reasonable means to practical ends.

The objectives for each lesson were identified by an APH focus group and aligned to the Principles and Standards for School Mathematics (NCTM 2000). Standards are listed with the permission of the National Council of Teachers of Mathematics




(NCTM). NCTM does not endorse the content or the validity of these alignments.

In addition, some objectives are noted as being a NCTM Curriculum Focal Point. In 2006 the National Council of Teachers of Mathematics published *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence*. In this document NCTM provides a “description of the most significant mathematical concepts and skills at each grade level” (NCTM, 2006, p. 1).

“The Common Core State Standards Initiative is a state-led effort coordinated by the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO). The standards were developed in collaboration with teachers, school administrators, and experts, to provide a clear and consistent framework to prepare our children for college and the workforce.” (Common Core State Standards 2010, About the Standards section, para.1) The final Common Core State Standards were released on June 10, 2010. Objectives in this unit that align with a Common Core Standard are noted and the standard number is listed.


Included at the end of this unit is an Assessment Checklist that includes all of the objectives for the



unit. This checklist is divided by grade levels. Prior to beginning the activities, review the checklist to determine which objectives your student has mastered and which objectives you will need to teach or review. Because some students have gaps in their skills, you may want to review the objectives for the preceding grade level/levels. Additionally, your school or district may align the math curriculum differently. You may find that you will need to teach lessons that are included at a different grade level or delay some objectives until the next school year.

Some children will need more time and experience with activities involving measurement than others. The following lessons, as a rule, provide only one worksheet per lesson. If your student needs more practice, less difficult activities or more challenging activities, use products like *Focus in Math*, *DRAFTSMAN*, and the diagramming strips from *Picture Maker* that will allow you to create problems and activities to meet your child's specific needs.

As you use the worksheets with your students, please note that the directions for Kindergarten will ask the student to "find" the answer. Students may tell the answer, show the answer, or mark the answer in the fashion he or she has




been taught. In grades one through three, the directions will ask the students to “mark” the answer. Some teachers may want the child to color the answer, underline the answer, mark with stickers or Wikki Stix, or designate the answer in another fashion. The directions are not specific in how to “mark” the answer in order to allow for individual differences.

Literature plays an important role in the learning process. There are many good children’s books that reinforce math concepts. Following is a list of books you may want to use to introduce or reinforce the concepts of measurement. Not all are available in braille and some are dependent on pictures to convey meaning.

- Aber, Linda (2001). *Carrie measures up*. New York: Kane Press.
- Adler, David (1999). *How tall, how short, how far away*. New York: Holiday House.
- Albee, Sarah (1998). *The dragon scales*. New York: Random House Books for Young Readers.
- Axelrod, Amy (1996). *Pigs on a blanket: fun with math and time*. New York: Simon & Schuster Books for Young Readers.
- Barner, Bob (1995). *How to weigh an elephant*. New York: Bantam Books for Young Readers.

- Briggs, Raymond (1970). *Jim and the beanstalk*. New York: Putnam.
- Browning, Dave (2000). *Marvin measures up*. New York: HarperFestival.
- Browning, Dave (2000). *Marvin weighs in*. New York: HarperFestival.
- Bruce, Sheila (2001). *Everybody wins*. New York: Kane Press.
- Carlstrom, Nancy White (1986). *Jesse Bear, what will you wear?* New York: Simon & Schuster.
- Clement, Rod (1995). *Counting on Frank*. New York: Houghton Mifflin. [braille]
- Dussling, Jennifer (2000). *The 100-pound problem*. New York: Kane Press.
- Fowler, Allan (1994). *Hot and cold*. New York: Children's Press.
- Heit, Robert (1969). *The day that Monday ran away*. New York: Lion Books.
- Herman, Gail (2001). *Keep your distance*. New York: Kane Press.
- Hutchins, Pat (1994). *Clocks and more clocks*. New York: Aladdin Books.
- Kachenmeister, Cherryl (1989). *On Monday when it rained*. Boston: Houghton Mifflin. [braille]

- Lafferty, Peter (1991). *Archimedes*. New York: Bookwright Press.
- Leedy, Loreen (2002). *Follow the money!* New York: Holiday House.
- Leedy, Loreen (2001). *Measuring Penny*. New York: Henry Holt and Co. [sound]
- Lilli, Patricia (1993). *When this box is full*. New York: Greenwillow Books. [braille]
- Lionni, Leo (1960). *Inch by inch*. New York: HarperCollins Children's Books. [braille]
- Maestro, Betsy (1984). *Around the clock with Harriett: a book about telling time*. New York: Crown.
- Murphy, Stuart J. (1996). *The best bug parade; comparing sizes*. New York: Harper Trophy.
- Murphy, Stuart J. (2000). *Pepper's journey*. New York: HarperCollins Publishers.
- Murphy, Stuart J. (1999). *Super sand castle Saturday*. New York: Harper Trophy.
- Myller, Rolf (1991). *How big is a foot?* New York: Dell Publishing Company. [braille]
- Russon, Marisabina (1986). *The line up book*. New York: Greenwillow Books, William Morrow and Co. [braille]
- Schlein, Miriam (1984). *Heavy is a hippopotamus*. New York: Children's Press.

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- Schwartz, David (2003). *Millions to measure*. New York: HarperCollins.
 - Shulevitz, Uri (1993). *One Monday morning*. New York: Mcmillan/McGraw Hill. [braille]
 - Sweeney, Joan (2000). *Me counting time: from seconds to centuries*. New York: Crown Publishers.
 - Taylor, Barbara (1990). *Weight and balance*. New York: Franklin Watts.
 - Viorst, Judith (1988). *Alexander, who used to be rich last Sunday*. New York: Aladdin Books. [braille]
 - Wells, Robert E. (1993). *Is the blue whale the biggest thing there is?* Morton Grove, Illinois: Albert Whitman & Co.
 - Williams, Rozanne (2001). *The coin counting book*. Watertown, MA: Charlesbridge.





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National Council of Teachers of Mathematics (2006). *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence*. Reston, VA: National Councils of Teachers of Mathematics.

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Common Core State Standards. (June 2010) *About the Standards*. Retrieved October 22, 2010, from Common Core State Standards Initiative, Preparing America's Students for College and Career Online via:
<http://www.corestandards.org/about-the-standards>






Learning Objectives


Kindergarten

- | | |
|---------|----------------------------------------------------------------------------------------------------------------------------------------|
| ME K-1 | Demonstrate an understanding of the periods of a day (morning, afternoon, evening, night) and common activities associated with each. |
| ME K-2 | Demonstrate an understanding of the concepts of time as it relates to day sequence (today, yesterday, and tomorrow). |
| ME K-3 | Recognize and compare attributes of time by comparing events according to duration (more time than, less time than). |
| ME K-4 | Demonstrate awareness of relative lengths of time (minute, hour, day, week, month, and year). |
| ME K-5 | Identify coins and their value based upon physical attributes. |
| ME K-6* | Compare the length of objects by making direct comparisons with reference objects using nonstandard units (longer, shorter, or equal). |

- 
- ME K-7 Compare relative weight of common objects using nonstandard units (heavier, heaviest, lightest, same as).
- ME K-8 Compare relative liquid volume (capacity) of containers using nonstandard units (more, less, same as).


First Grade

- ME 1-1 Identify parts and functions of an analog (conventional) clock.
- ME 1-2 Tell time to the hour using an analog clock.
- ME 1-3 Tell time to the half-hour using an analog clock.
- ME 1-4 Name the days of the week and the months of the year in sequence.
- ME 1-5 Use a calendar to identify dates including the days of the week and months of the year.
- ME 1-6 Identify and order coins with respect to value: penny, nickel, dime, quarter, and half-dollar.

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|---------|-----------------------------------------------------------------------------------------------------------------------------|
| ME 1-7 | Identify equivalency relationships between coins and show different combinations of coins that equal the same value. |
| ME 1-8* | Read and write money notation of cents (¢) in Nemeth or UEB Code. |
| ME 1-9 | Solve real-world problems related to cost and purchasing of items. |
| ME 1-10 | Compare and measure the length of objects using nonstandard and standard units. |
| ME 1-11 | Compare relative temperatures of common objects or situations using nonstandard units (hot/cold, warm/warmer, cool/cooler). |
| ME 1-12 | Identify parts and functions of a balance scale and a talking scale. |
| ME 1-13 | Estimate and measure the weight of objects using nonstandard and standard units. |
| ME 1-14 | Estimate and measure liquid volume (or capacity) in nonstandard and standard units. |


Second Grade

- ME 2-1 Tell time to the nearest hour, half-hour, and quarter-hour using an analog clock.
- ME 2-2 Recognize the number of minutes in an hour, half-hour, and quarter-hour.
- ME 2-3 Determine the value of a collection of coins up to \$1.00.
- ME 2-4* Read and write money notation in Nemeth or UEB Code (cent [¢], dollar sign [\$], and the decimal point).
- ME 2-5 Determine estimates and actual costs of various items.
- ME 2-6* Measure the length of objects using standard units (English and metric).
- ME 2-7 Identify the parts and functions of a thermometer.
- ME 2-8 Estimate and measure temperature using a thermometer and compare using common descriptions such as warm, hot, cold, cool, etc.

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|---------|------------------------------------------------------------------------------------------|
| ME 2-9 | Estimate and measure the weight of objects using standard units (English and metric). |
| ME 2-10 | Estimate and measure liquid volume (capacity) using standard units (English and metric). |

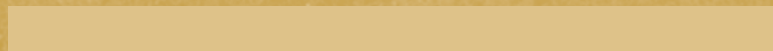
Third Grade

- | | |
|---------|---------------------------------------------------------------------------------------------|
| ME 3-1 | Tell time on an analog clock at five minute intervals. |
| ME 3-2 | Count and represent combined coins in dollar amounts using currency symbols (\$0.00). |
| ME 3-3 | Identify and count combinations of bills including one, five, ten, and twenty dollar bills. |
| ME 3-4* | Add and subtract amounts of money up to \$9.99 with no regrouping. |
| ME 3-5 | Estimate and measure the length of objects using the English system. |
| ME 3-6 | Estimate and measure the length of objects using the metric system. |

- 
- ME 3-7 Measure the temperature in degrees Fahrenheit using a thermometer.
- ME 3-8 Carry out simple unit conversions of English and metric units of weight (mass).
- ME 3-9 Carry out simple unit conversions of English and metric units of liquid volume (capacity).
- ME 3-10* The student will estimate and measure the length, liquid volume (capacity), or weight of a given object by choosing the appropriate measuring tools and units.

*Worksheet included

Kindergarten






Learning Objectives

Kindergarten

- | | |
|--------|---------------------------------------------------------------------------------------------------------------------------------------|
| ME K-1 | Demonstrate an understanding of the periods of a day (morning, afternoon, evening, night) and common activities associated with each. |
| ME K-2 | Demonstrate an understanding of the concepts of time as it relates to day sequence (today, yesterday, and tomorrow). |
| ME K-3 | Recognize and compare attributes of time by comparing events according to duration (more time than, less time than). |
| ME K-4 | Demonstrate awareness of relative lengths of time (minute, hour, day, week, month, and year). |
| ME K-5 | Identify coins and their value based upon physical attributes. |

- 
- ME K-6* Compare the length of objects by making direct comparisons with reference objects using nonstandard units (longer, shorter, or equal).
- ME K-7 Compare relative weight of common objects using nonstandard units (heavier, heaviest, lightest, same as).
- ME K-8 Compare relative liquid volume (capacity) of containers using nonstandard units (more, less, same as).

*Worksheet included



Materials Suggested for Lessons

A limited number of manipulatives are included in the kit that accompanies this unit. Additionally, you may want to use the following items to add variety and to give the child more experiences with objects from his or her environment.

APH Individual Calendar Kit, ME K-2, K-4

Currency: pennies, nickels, and dimes, ME K-5

Containers for comparison of capacity, ME K-8

Liquids, ME K-8

Marbles, ME K-8

Objects

- for comparison of length, ME K-6

- for comparison of weight, ME K-7

Sand, ME K-8

Scoop, ME K-8

ME K-1

Measurement


Objective: The student will demonstrate an understanding of the periods of a day (morning, afternoon, evening, night) and common activities associated with each.

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should recognize the attributes of length, volume, weight, area, and time.

Suggested Materials:

Strategies: While there are many personal definitions of periods of day, most time periods will fall into the following time periods: morning, afternoon, evening, and night. Many individuals divide the day based upon the three meals. One example of time period divisions could be:

- Morning: Wake time (including breakfast) to lunch
- Afternoon: After lunch (or noon) until leaving school


- 
- Evening: Arriving home until bedtime (including dinner)
 - Night: Bedtime until wake time

Provide a general definition of each time period and use them in general discussion throughout the day. It is critical that the student correctly uses the terms appropriately in conversation.

Secondly, provide the student with direct questions that explore when events typically occur and the connected time period. This will be unique for each student.

Examples of questions that can be discussed orally with the student include:

- What period of the day do we eat breakfast?
- When do we brush our teeth? (Hopefully the student will say in the morning and in the evening/night before bed.)
- When do we take our nap?
- What time of the day do we eat dinner?
- What time of the day do we watch cartoons?



Also consider providing the student with option-based questions. For example:

- Which would happen at night: sleep or playing?
- Which would occur in the evening: playing or eating breakfast?
- Which would occur in the afternoon: riding the bus home or riding the bus to school?

Connections: Read the book *Jesse Bear, What Will You Wear?* by Nancy White Carlstrom. Discuss with the student what Jesse Bear will wear in the morning. What will he wear at noon? What does he do before he puts on his pajamas?

ME K-2

Measurement

Objective: The student will demonstrate an understanding of the concepts of time as it relates to day sequence (today, yesterday, and tomorrow).

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should compare and order objects according to these attributes.

Suggested Materials:

- APH Individual Calendar Kit

Materials: *Listed materials are only a suggestion. Feel free to substitute other appropriate materials including those from other math programs.*

Strategies: This objective will best be completed during work with calendars in the classroom. When exploring the daily calendar, discuss not only the day of the week and day of the month but also focus on direct questioning related to day sequence.




During the calendar activity, have the student determine what day of the week is today.

Next, ask the student what day of the week was yesterday and what day of the week will be tomorrow.

After exploring the sequence of days, pose questions to the student to explore conceptual understanding of events that are connected to the vocabulary. Ask the student what happened yesterday, what are the plans for today, and what will he do tomorrow. The focus of the questioning should be on the student's understanding that yesterday is in the past, today is the present, and tomorrow is the future.

Connections: Read the book *On Monday When it Rained* by Cherryl Kachenmeister. In this book each day of the week brings a new happening to a young boy. After reading and discussing the book, choose a specific day from the story and ask "What happened today? What happened yesterday? What will happen tomorrow?"



ME K-3

Measurement


Objective: The student will recognize and compare attributes of time by comparing events according to duration (more time than, less time than).

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should compare and order objects according to these attributes.

Common Core State Standards for Mathematics: K.MD-1, 2

Suggested Materials:


Strategies: In this lesson, the student will develop a deeper understanding of relative time by comparing events. The student should be able to recognize that time periods are not always equal and that certain events are “more” or “less” than other events.



Ask the student questions that allow for the exploration of relative time.

Examples:

- Which takes a longer amount of time: eating a snack or eating a meal?
- Which takes a longer amount of time: washing dishes or washing cars?
- Which takes a longer amount of time: washing your face or taking a bath?
- Which takes a longer amount of time: emptying crayons out of the box or putting crayons into the box?
- Which takes a shorter amount of time: taking an elevator or taking the stairs?
- Which takes a shorter amount of time: zipping up a coat or buttoning up a coat?
- Which takes less time: walking to school or riding the bus?
- Which takes less time: brushing a horse or brushing a small dog?
- Which takes more time: taking out toys or putting toys away?
- Which takes more time: taking a nap or sleeping all night?



The key is for the student to understand terminology such as “longer,” “shorter,” “less,” and “more.”

Connections: The concept of comparing time is a significant step to the ultimate goal of independent travel. The student needs to be able to think about common activities and estimate relative time. The O&M specialist could provide the student with questions before activities regarding the length of time. For example: “Which will take longer: getting to the restroom or getting to the gymnasium?” Being able to estimate times, beginning with “more” or “less” is the first step of developing strong mobility skills.

ME K-4

Measurement

Objective: The student will demonstrate awareness of relative lengths of time (minute, hour, day, week, month, and year).


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should recognize the attributes of length, volume, weight, area, and time.

Suggested Materials:

- APH Individual Calendar Kit

Strategies: In this lesson the student will be introduced to the terms minute, hour, day, week, month, and year. The student may have a general understanding of some of the terminology, but focus on developing the relationships between the lengths of time.


Begin by exploring the idea of the length of the minute. Using a one-minute timer or sand glass, have the student sit quietly without moving for



a minute. Discuss activities or events that take a minute such as a commercial, a short song, etc. Next, discuss the idea that a minute is smaller than an hour. Supply the student with ideas of activities that take an hour (two cartoon shows, reading period, etc.). To provide an hour experience, begin an activity by explaining that you are going to do the activity for one hour and actually say “Start.” At the one hour mark, stop what you are doing and say “The hour has ended.” Ask the student what he has done within the last hour.

The concepts of day, week, month, and year should be connected to calendar activities. Using the Individual Calendar Kit, have the student identify a day, a week, and a month. Have the student determine the number of days in a week and the number of days in different months.

The student needs to understand the size of each time period. The student needs to know that a minute is less than an hour, an hour is less than a day, a day is more than an hour, etc. Simple questions such as “Which is longer, a day or a week?” can be used to explore this concept.



Provide the student with common activities that take an approximate amount of time. Examples:

- Minute: Commercial, short song
- Hour: Two cartoon shows, reading class
- Day: School, trip to amusement park, trip to the zoo
- Week: Spring Break, Christmas Break, learning spelling words
- Month: December
- Year: Kindergarten

Connections: Read the book *Pepper's Journey* by Stuart J. Murphy. This book investigates the concepts of calendar time through the events of a kitten's first year. The concept of time is fully integrated into the story. A monthly calendar appears on each double-page spread showing the progression of days, weeks, and months.

ME K-5

Measurement

Objective: The student will identify coins and their value based upon physical attributes.


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should compare and order objects according to these attributes.

Suggested Materials:

- Currency: coins (pennies, nickels, and dimes)

Strategies: It is crucial that a student with a visual impairment is able to discriminate between coins tactually. Begin by providing the student with an explanation of the differences between coins based upon:

- Size (diameter and width)
- Material
- Weight
- Edge (ribbed versus smooth)
- Pictures




Begin with the penny and discuss the characteristics of the coin (thin, copper, light material, smooth edge, pictures). Have the student describe the coin using her own terminology. Next, provide the student with a nickel and explain its characteristics while the student explores the coin. Next, have the student orally compare the two coins. Continue this exercise with dimes.

Provide the student with a collection of coins and have the student sort the coins using the student's understanding of the tactile characteristics of the coins.

Once the student can differentiate between the coins, move to the development of value of the coins. At this point, focus on simple values. Explain that a penny is equal to 1 cent. Progress through the sequence: 2 pennies is 2 cents, 3 pennies is 3 cents, etc. up to 10 pennies or 10 cents. The student should develop an understanding that pennies represent ones.

Provide the student with a nickel. Explain that the nickel is equal to 5 cents. Ask the student if she knows how many pennies it would take to equal one nickel. You may need to repeat the concept that 1 penny is 1 cent, 2 pennies is 2 cents, etc. until you get to 5 cents.



Once the connection has been made between 5 pennies and a nickel, ask the student to show you 7 cents using a nickel and pennies. Provide the student with multiple problems involving simple addition using pennies and nickels.

Finally, provide the student with 10 pennies and ask how many cents the student has? (She should respond 10 cents.) Next, provide the student with 2 nickels and ask how many cents the student has. (This may take some extra work for the student to add 5 cents and 5 cents but the student should determine that 2 nickels are also equal to 10 cents.) Once the student understands these two concepts, present a dime and explain that a dime is worth 10 cents. Explain to the student that 10 pennies, 2 nickels, and 1 dime are all equal.

If the student is able to add up to 20, you can provide the student with various combinations of coins that add up to numbers less than 20.

Examples:

- 4 pennies, 1 nickel, 1 dime (19 cents)
- 2 pennies, 1 dime (12 cents)
- 2 nickels (10 cents)
- 1 nickel, 1 dime (15 cents)

- 3 pennies (3 cents)
- 6 pennies, 1 nickel (11 cents)
- 3 nickels (15 cents)
- 10 pennies, 1 nickel (15 cents)
- 1 penny (1 cent)
- 1 penny, 1 nickel, 1 dime (16 cents)

Connections: Take the student to the gym or playground. Give the student a paper bag filled with coins. As the child selects a coin from the bag, have the child say the name and value of the coin and then take that number of “baby steps” from a starting line. For example, if the child draws a dime, ten “baby steps” are taken. The teacher or another student may act as a partner taking turns with the student. Continue to draw coins from the bag and move that many steps toward the finish line. This activity also introduces the concept of movement on a number line.



ME K-6

Measurement

Objective: The student will compare the length of objects by making direct comparisons with reference objects using nonstandard units (longer, shorter, or equal).

NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should use repetition of a single unit to measure something larger than the unit, for instance, measuring the length of a room with a single meterstick.

NCTM Curriculum Focal Point


Common Core State Standards for Mathematics: K.MD-2

Suggested Materials:

- Objects for comparison of length

Worksheet ME K-6


Strategies: Nonstandard units can be anything that is used as criteria of length. For example,



a large area may be referred to as being three football fields in size. The football field is the nonstandard unit. On a smaller scale, you could take a paper clip and determine the length of a sheet of paper (such as six paperclips). Using nonstandard units is a prerequisite skill for measuring using standard units (inches, feet, meters, etc.).

For this lesson, begin by developing an understanding of comparison terms: shorter, longer, equal. Give the student a nonstandard unit of measure such as a plastic spoon. Present the student with objects that are longer, shorter, and equal to the object. Once the student demonstrates competency with the objects you provide, present another object that is a different length. Have the student travel around the room comparing the object to objects in the classroom and determine if they are longer, shorter, or equal in length.


Have the student participate in a length scavenger hunt. Place five to six items that are of different lengths in a box. Have the student select an item and then find another object in the class that is longer. Once the student has emptied the box put the objects back in the box and repeat the exercise by having the student find objects



that are shorter. Make sure that the student understands the comparison by having the student say which object is longer or shorter. For example, assume you are using a paperclip as your nonstandard unit object from the box. The student searches the room and finds a pencil. He returns both of the objects to you and says, “This pencil is **longer** than this paperclip.” It is best to try to incorporate the concept of equality in this exercise also but you may need to ensure that there are objects that are of equal length in the classroom.

After the student has a well-developed understanding of comparison of length, focus on the concept of using nonstandard measurements for comparison. To do this, first select a nonstandard unit as a measure such as paperclips, Unifix[®] Cubes, or APH tactile stickers. Demonstrate to the student how to measure objects by using the nonstandard unit. For example, have the student measure the length of a Perkins/APH Braille using paperclips. Repeat this exercise with other nonstandard units.

Once the student is able to measure using nonstandard units, provide the student with two objects such as a toy car and a book. Have the student measure each object using the nonstandard unit. Then ask the student to



determine which is longer or shorter. Again, this may not be intuitive to the student so you may need to lead the student through the process through questioning. Repeat this exercise with multiple objects and various nonstandard units.

Complete worksheet ME K-6.

Connections: The student's ability to measure relative length based upon stride (length of steps) or landmarks (such as doorways) is a critical first step to orientation. Working with the O&M specialist, the student can be given activities to determine the distance between point A and point B using different nonstandard units of measure. The O&M specialist could have the student determine the length of a long hallway by counting the number of steps or the number of classrooms.



ME K-7

Measurement

Objective: The student will compare relative weight of common objects using nonstandard units (heavier, heaviest, lightest, same as).

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should compare and order objects according to these attributes.

Common Core State Standards for Mathematics: K.MD-2

Suggested Materials:

- Objects for comparison of weight

Strategies: The student may have a general understanding of the term “heavy” and “light” from past experiences. For this activity, the student will compare relative weight.

Begin by providing the student with two objects that have an extreme weight difference such as a pencil and a metal stapler. Have the student hold one object in each hand at the same time and ask



a series of questions, such as:

- What is in your right hand?
- What is in your left hand?
- Are they different or alike (the same)?
- What makes them different? (Allow the student to provide physical descriptions. Listen intently to determine if the student discusses the differences in weight).
- Which one is **heavier**?
- Why is it heavier? (Answer: Because it **weighs** more. You may have to supply this answer.)
- Which one is **lighter**?
- Why is it **lighter**? (Answer: Because it **weighs** less. Again, you may have to supply this answer.)

Have the student put the objects in the opposite hands and ask if the heavier object is still heavier. It is important that the student understands that weight is not related to position (which hand the object is in) but is based upon the weight of the object.

Provide the student with various objects to compare. Start with objects that are extremely different in weight and slowly move to two objects



that are equal in weight. At this point, discuss how objects can weigh the same.

Make sure to provide the student with examples where the smaller object in size is actually heavier than the other object (small metal ball versus a filled balloon). This is to ensure that the student is not relating size to weight.

Connections: Read the book *Marvin Weighs In* by Dave Browning. The story follows Marvin's obsession for weighing everything he sees, including the coins in his purse. As you read the story ask the student to predict which objects will be heavy and which objects will be light.

ME K-8

Measurement


Objective: The student will compare relative liquid volume (capacity) of containers using nonstandard units (more, less, same as).

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should compare and order objects according to these attributes.

Suggested Materials:

- Various containers of different sizes
- Marbles
- Sand
- Scoop
- Liquids


Strategies: In this lesson the student will learn to compare capacity of containers using nonstandard units. Begin by providing the student with various containers of different sizes. Allow the student to explore the containers. Next, select two of the containers (small containers may work best for this exercise). Provide the student with a bag



of marbles or any other nonstandard unit that can be counted later. Ask the student to fill the two containers with the marbles. When the student is finished, have him predict which container holds more marbles. Help the student count the marbles in each container and compare the correct answer to the prediction provided by the student. This exercise can be completed multiple times with different containers to develop understanding. As an extension, you can have the student compare the empty containers and predict which container will hold more marbles.

Take your student outside to an area where you can play with sand or a sandbox if there is one at the school. Following the same steps as with the marble exercise, have the student use a cup, scoop, or measuring cup to add sand to the containers. Have the student count the number of scoops that it takes to completely fill the containers. Again, the purpose of this exercise is for the student to be able to determine relative capacity and compare the containers. As an extension, the same activities could be completed with liquids.

Connections: The understanding of relative liquid volume is an important independent living skill. Having an understanding of liquid volume



including comparing volume of containers is necessary for cooking, cleaning, maintenance of a home, and even personal care. Provide the student with various examples of products that may be used around the home that come in different sizes. Have the student determine which container holds more liquid.






First Grade



Learning Objectives

First Grade

- | | |
|--------|----------------------------------------------------------------------------------------------------------------------|
| ME 1-1 | Identify parts and functions of an analog (conventional) clock. |
| ME 1-2 | Tell time to the hour using an analog clock. |
| ME 1-3 | Tell time to the half-hour using an analog clock. |
| ME 1-4 | Name the days of the week and the months of the year in sequence. |
| ME 1-5 | Use a calendar to identify dates including the days of the week and months of the year. |
| ME 1-6 | Identify and order coins with respect to value: penny, nickel, dime, quarter, and half-dollar. |
| ME 1-7 | Identify equivalency relationships between coins and show different combinations of coins that equal the same value. |

- 
- | | |
|---------|-----------------------------------------------------------------------------------------------------------------------------|
| ME 1-8* | Read and write money notation of cents (¢) in Nemeth or UEB Code. |
| ME 1-9 | Solve real-world problems related to cost and purchasing of items. |
| ME 1-10 | Compare and measure the length of objects using nonstandard and standard units. |
| ME 1-11 | Compare relative temperatures of common objects or situations using nonstandard units (hot/cold, warm/warmer, cool/cooler). |
| ME 1-12 | Identify parts and functions of a balance scale and a talking scale. |
| ME 1-13 | Estimate and measure the weight of objects using nonstandard and standard units. |
| ME 1-14 | Estimate and measure liquid volume (or capacity) in nonstandard and standard units. |

*Worksheet included



Materials Suggested for Lessons

A limited number of manipulatives are included in the kit that accompanies this unit. Additionally, you may want to use the following items to add variety and to give the child more experiences with objects from his or her environment.

Braille labels, ME 1-9

Braille paper, ME 1-8

Calendar

- classroom, ME 1-4, 1-5

Currency: pennies, nickels, dimes, quarter,
half-dollar, ME 1-6, 1-7

Objects

- for purchasing activity, ME 1-9

- for nonstandard measurement of lengths,
ME 1-10

- for comparison of temperature, ME 1-11

- for comparison of weight, ME 1-12, 1-13

- for comparison of volume, ME 1-14

Perkins/APH Braille, ME 1-8

Talking scale, ME 1-12

ME 1-1

Measurement

Objective: The student will identify parts and functions of an analog (conventional) clock.

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should select an appropriate unit and tool for the attribute being measured.


Common Core State Standards for Mathematics: 1.MD-3

Materials: Listed materials are only a suggestion. Feel free to substitute other appropriate materials including those from other math programs.

Suggested Materials:

- APH Analog Clock Model


Strategies: Begin by explaining to your student that there are two types of clocks: analog and digital. It is important that the student is able to work with both.



Provide the student with the APH Analog Clock Model and follow these steps:

- Allow the student to explore the APH Analog Clock Model.
- Using hand-under-hand, help the student explore the “face” of the clock. Explain that number 12 is at the very top. As you move around the clock to the right, you find the numbers 1 through 12.
- Give the student different numbers and have the student find the numbers on the face of the clock.
- Upon mastery of the numbers on the clock face, show the student the hands of the clock. Begin with the small hand and explain that this is the “hour” hand. Then present the long hand and explain that this is called the “minute” hand. At this point, it is not necessary to explain the concept of an hour versus a minute, the student only needs to understand that there are two hands on a clock and each has a different name. However, you can explain that the clock hands tell us the time in both hours and minutes, such as 1:35.

If you have an analog wrist watch, you can allow the student to explore it and discuss how it has the same features as the APH Analog Clock.



If a digital clock is available, allow the student to examine the clock. Explain the mechanical features of the clock and then discuss the connection between analog and digital clocks. Explain to the student that all digital clocks present the information in a specific way with the hour first, a colon, then the minutes.

If a digital talking clock is available, you can conduct the same activity with the student and use the talking feature of the clock/watch.

Connections: The understanding of the clock face is critically important for advanced orientation and mobility skills. Being able to provide a student traveling directions by using the clock face is a useful strategy used by many Orientation and Mobility Specialists. It may be appropriate to collaborate with your O&M specialists to reinforce these concepts.



ME 1-2

Measurement

Objective: The student will tell time to the hour using an analog clock.


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should compare and order objects according to these attributes.

Common Core State Standards for Mathematics: 1.MD-3

Suggested Materials:

- APH Analog Clock Model
- APH Clock Face Sheets in Braille


Strategies: Provide the student with the APH Analog Clock Model. Review the parts of the clock while focusing on the “hour” hand and the hour numbers. Explain to the student that he will be learning how to read time to the hour using the analog clock. Give him examples of hours that are important such as breakfast at 7 a.m., lunch at 12 noon, going home at 3 p.m., cartoons at 4 p.m., etc.



Set the clock to 1:00. Explain to the student that to determine the hour, we have to determine where the small hand is on the clock face. Provide the student with multiple examples of times (3:00, 6:00, 8:00, 11:00, etc.). Make sure to provide the student with an example of 12:00 once he has mastered the other hours. If a student is having a hard time determining the time on the face of the clock, provide the student with a pencil or other device to “extend” the hour hand.

Using APH Clock Face Sheets in Braille, provide the student with multiple times on the embossed sheets. Have the student determine the hour for each clock. For some students, it may be appropriate to only use the hour hand until the student has a strong understanding of the hour.

When the student has a solid understanding of telling the time on the hour, explain that the hour hand is not always directly on the hour, sometimes it is between numbers. Explain that as a rule when telling time with an analog clock, if the hour hand is between two numbers that the smaller number is the hour. Provide the student with an example such as 7:20. Show the student that the hour hand is between 7 and 8, so we would say we are in the 7th hour, or 7 o’clock. Give the student multiple examples. Once the student is demonstrating



proficiency with this concept, provide unique examples such as 6:30 and 12:45 which may be more difficult to determine. The student should be expected to note the correct hour for each example.

It is important to make the connections between the analog and digital clock. The student must understand that these different clocks provide the same information. It is also important that the student understand that the clocks start over after 12. It may be appropriate with some students to discuss that we have 24 hours in a day and that clocks rotate through all the numbers twice in one day.

Connections: Read the book *Clocks and More Clocks* by Pat Hutchins. When the hall clock reads twenty minutes past four, the attic clock reads twenty-three minutes past four, the kitchen clock reads twenty-five minutes past four, and the bedroom clock reads twenty-six minutes past four, what should Mr. Higgins do? He can't tell which of his clocks tells the right time. He is in for a real surprise when the Clockmaker shows him that they are all correct!

ME 1-3

Measurement

Objective: The student will tell time to the half-hour using an analog clock.


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should compare and order objects according to these attributes.

Common Core State Standards for Mathematics: 1.MD-3

Suggested Materials:

- APH Analog Clock Model
- APH Clock Face Sheets in Braille







Strategies: Begin by having a discussion with the student about time. Provide examples of times during the day that have events attached to them. Begin with events that begin on the hour (1:00 p.m. or 3:00 p.m.). Then discuss events that occur on the half-hour (3:30 p.m. could be the time of a favorite cartoon or 8:30 p.m. may be bedtime).




Explain to the student that she will be learning how to read time to the half-hour. Provide the student with the APH Analog Clock Model. Allow the student to explore the clock and review the use of the hour hand to determine the hour. Place the minute hand on the 6 and have the student locate the minute hand. Ask the student to determine the location of the minute hand (she should say on the 6 or “straight down”). Explain to the student that when the minute hand is on the 6 this represents the half-hour. Give the student multiple examples and have the student determine the time (both hour and half-hour). The student should make note that the minute hand is always on the 6 and that the hour hand is always between two numbers.

Using the APH Clock Face Sheets in Braille, give the student multiple problems to read. Include both hour and half-hour times (1:00 and 1:30).

Throughout the lesson, you may want your student to read simple times. In order to do this, you will need to provide instruction on how times are written using Nemeth or UEB Code. This includes the appropriate use of the colon and the numeral and punctuation indicators.

Examples:	Nemeth	UEB
3:00		
1:30		
11:45		

Connections: Read the book *Me Counting Time: From Seconds to Centuries* by Joan Sweeney. In this book a little girl approaching her seventh birthday introduces children to the elements of time from seconds to minutes, hours, days, weeks, months, and years, using concrete examples from her life to illustrate the concepts.



ME 1-4

Measurement

Objective: The student will name the days of the week and the months of the year in sequence.

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should recognize the attributes of length, volume, weight, area, and time.

Suggested Materials:

- APH Classroom Calendar Kit
(not provided in kit)
- APH Individual Calendar Kit

Strategies: There are multiple strategies that can be used to teach the student to name the days of the week and the months of the year in sequence. These may include singing, daily calendar work, and listing days. Here are some examples of activities that can be used for all students:



Days of the week

(to the tune of “The Addams Family”)

Days of the week, (snap snap)

Days of the week, (snap snap)

Days of the week,

Days of the week,

Days of the week. (snap snap)

There’s Sunday and there’s Monday,
There’s Tuesday and there’s Wednesday,
There’s Thursday and there’s Friday,
And then there’s Saturday.

Days of the week, (snap snap)

Days of the week, (snap snap)


Days of the week,

Days of the week,

Days of the week. (snap snap)

There are many other songs that can be used to teach the days of the week in sequence. It is very important that the sequence is correct and begins with Sunday, not Monday.

At the beginning of each day, have the student explore the APH Classroom or Individual Calendar to determine the day of the week as well as the date and month.



Provide the student with the labels of the days of the week found in the APH Individual Calendar Kit. Have the student put the labels in order.


In general, learning the months in sequence follows the same pattern. Use songs or rhymes to teach the sequence.

The Months of the Year

(To the Tune of “Three Blind Mice”)

January, February, March,
April, May, June.
July, August, September,
October, November, December.
These are the twelve months of the year.
Now sing them together so we can all hear.
How many months are there in a year?
Twelve months in a year.

Continue calendar work throughout the year. Have the student put the months in order using the labels provided in the APH Individual Calendar Kit.



It is important to stress to the student that the days of the week and the months of the year repeat similar to the clock. Obvious principles can be taught through these exercises including the number of days in a week or that Saturday and Sunday are considered the weekend.

Connections: Read the book *One Monday Morning* by Uri Shulevitz, available in braille. In this story, a queen and a prince come to visit a small boy one Monday morning, but as he tells readers, “I wasn’t home.” They return with the king on Tuesday, but “I wasn’t home.” Every day they check to see if the little boy is in, always with someone new in tow, until Sunday, when they come with a king, a knight, a royal guard, cook, barber, jester and a little dog. This time, the little boy is home to entertain his royal guests.



ME 1-5

Measurement


Objective: The student will use a calendar to identify dates including the days of the week and months of the year.

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should select an appropriate unit and tool for the attribute being measured.

Suggested Materials:

- APH Classroom Calendar Kit
(not provided in kit)
- APH Individual Calendar Kit


Strategies: The APH Classroom Calendar Kit includes both large print and Braille making it suitable for all students. The general education teacher needs to include the student with visual impairments in the classroom calendar activities. This means providing the student the opportunity to approach the calendar and determine the date tactually.



The student can also be provided an Individual Calendar while the classroom discussion is occurring. Spend time teaching the basic concepts of how the calendar is set up. Explain the common abbreviations that are used for the days of the week (M = Monday, T = Tuesday, W = Wednesday, Th = Thursday, F = Friday, and S = Saturday and Sunday).

Ask the student to determine on what day of the week a specific date occurs. Conversely, ask the student to determine the dates that occur on a specific day within a month. Review with the student the terms yesterday, today, and tomorrow and have the student locate a day on the calendar that matches these terms.

At the beginning of the semester, it may be more appropriate to create the individual calendar and teach the student how to read the calendar. However, during the year, the student should have the opportunity to help build the calendar. This will help develop a stronger understanding of the calendar.



Connections: Read *When This Box Is Full* by Patricia Lilli. The left page of each spread features a cumulative list of the months of the year, which grows longer as the book progresses. An unseen narrator names the seasonally appropriate items he will place in the box—one for each successive month.

ME 1-6

Measurement


Objective: The student will identify and order coins with respect to value: penny, nickel, dime, quarter, and half-dollar.

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should compare and order objects according to these attributes.

Suggested Materials:

- Currency: penny, nickel, dime, quarter, half-dollar

Strategies: The first objective is for the student to be able to identify coins tactually. For these activities, it is imperative to use real coins. Begin by providing the student with the penny and asking the student to describe the characteristics (including weight, material, edge, and picture). Have the student explore each coin and verbally describe how the coins differ. Note that the penny and nickel have smooth edges and the dime and quarter have grooved edges. The student should also note the difference in the size of each coin.




Once the student can differentiate between the coins, provide a selection of coins and have the student sort the coins by type.


Provide the student with a penny and explain that the penny is the smallest amount of money, or 1 cent. Next explain that a nickel is worth 5 cents, or 5 pennies. Ask the student if this makes the nickel worth more or less than a penny. Move through the coins in order and with each coin explain its value in cents. Make sure to compare each coin with other coins so that the student develops an understanding of comparative value.

Another way of demonstrating the value of coins is to stack pennies based upon the worth of the coins. Have the student compare the height of the stacks of pennies and relate them to the value of the individual coin.

Have the student place the coins (penny, nickel, dime, quarter, and half-dollar) in order, based on the value of each coin.



Connections: The ability to tactually discriminate objects based upon subtle differences is an important compensatory skill for students with visual impairments. Discrimination of coins is an example where these differences may be minute but are important to understand. Provide the student with an array of tactile textures in order to strengthen the student's ability to discriminate textures. The O&M specialist can reinforce this concept when traveling by having the student describe the texture of different paths (gravel, pavement, concrete, and grass) and unique textures (domes or ridges at wheelchair ramps).



ME 1-7

Measurement

Objective: The student will identify equivalency relationships between coins and show different combinations of coins that equal the same value.

NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should develop common referents for measures to make comparisons and estimates.

Suggested Materials:

- Currency:
 - 25 pennies
 - 10 nickels
 - 5 dimes
 - 4 quarters
 - 1 half-dollar

Strategies: Begin by reviewing the value of coins based upon the penny, or 1 cent. Once the student demonstrates understanding of this concept, begin showing the student other combinations for equivalency. Beginning with nickels, help the student determine equivalent combinations.




For example:

- Provide the student with 1 nickel and ask the student to explain the value in cents (5 cents).
- Provide the student with a second nickel and ask the value of both coins combined (10 cents).
- Ask the student if she can find one coin that is worth 10 cents (dime).
- Ask the student if the two nickels are worth the same as the dime (yes).

Complete similar discussions with basic combinations, including:

- 5 nickels = 25 cents = 1 quarter
- 2 dimes + 1 nickel = 25 cents = 1 quarter
- 5 dimes = 50 cents = 1 half-dollar
- 2 quarters = 50 cents = 1 half-dollar
- 10 nickels = 50 cents = 1 half-dollar



Once the student has mastered these basic combinations, include pennies to create more complex combinations, such as:

- 5 pennies + 2 nickels + 1 dime = 1 quarter
- 15 pennies + 1 dime = 1 quarter
- 2 dimes + 6 nickels = 1 half-dollar

Connections: Being able to determine different combinations of coins is important for many independent living skills from shopping to travel. One of particular interest to students is using a vending machine. The teacher or O&M specialist could reinforce this concept by allowing the student to purchase food or drinks from a vending machine. However, the student should only be allowed to purchase items if she can correctly determine the exact change needed to purchase the specific item.

ME 1-8

Measurement

Objective: The student will read and write money notation of cents (¢) in Nemeth or UEB Code.

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should select an appropriate unit and tool for the attribute being measured.

Suggested Materials:

- Perkins/APH Braille
- Braille paper

Worksheet ME 1-8

Strategies: The braille notation for the cent sign is a two cell combination. The first cell is dot 4 and the second cell is dots 1,4 (letter “c”).

¢ = ⠠⠉

Examples:	Nemeth	UEB
5¢ =	$\cdot\cdot\cdot\cdot\cdot\cdot$	$\cdot\cdot\cdot\cdot\cdot\cdot$
23¢ =	$\cdot\cdot\cdot\cdot\cdot\cdot$	$\cdot\cdot\cdot\cdot\cdot\cdot$

Introduce the student to the braille notation for ¢ and explain its use to signify amounts up to 99¢.

Provide the student with Worksheet ME 1-8 and have the student read the notation. Once the student has mastered reading the cents (¢) notation, have him write monetary expressions using the proper Nemeth or UEB Code.

Complete worksheet ME 1-8.

Connections: Read the book *Alexander, Who Used to Be Rich Last Sunday* by Judith Viorst. This is the story of a young boy who was given money by his grandparents. Alexander planned to save his money. And then there was bubble gum and all kinds of other things to spend money on. And now all he has is bus tokens. He used to be rich last Sunday.

ME 1-9

Measurement

Objective: The student will solve real-world problems related to cost and purchasing of items.


NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should develop common referents for measures to make comparisons and estimates.

Suggested Materials:

- Objects for purchasing activity
- Braille labels

Strategies: Assemble a selection of small items that the student might like to purchase. Add Braille “price tag” labels to all the objects and place them in a box. Allow the student to explore the box and read the price of the objects. The objects should cost small amounts that are understandable to the student such as 3¢ or 12¢. Once the student has explored the box of objects, explain that the student will be pretending to buy items.

Give the student a few coins. Have the student “purchase” as many items as she can afford with



the amount of money she was given. Review the identification of coins, value of coins, and simple addition and subtraction of coins as needed to complete this exercise. Repeat the shopping exercise using different combinations of coins.

Connections: In order to provide the student with an authentic learning experience, the teacher or O&M specialist should attempt to connect this classroom activity to a shopping activity in a real-world setting. Providing students with visual impairments the opportunity to shop and purchase items provides the student with a variety of experiences that are vital to being an independent adult.

ME 1-10

Measurement

Objective: The student will compare and measure the length of objects using nonstandard and standard units.


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should understand how to measure using nonstandard and standard units and use repetition of a single unit to measure.

NCTM Curriculum Focal Point

Common Core State Standards for Mathematics: 1.MD-2

Suggested Materials:

- Objects for nonstandard measurement of length (square stickers, paperclips, linking cubes, etc.)
- APH Metric-English Measurement Ruler with caliper




Strategies: Begin by providing the student with an object to measure using nonstandard units of measurement. For example, provide the student with a piece of Braille paper and have the student measure the length of the paper using paperclips as the nonstandard unit. Have the student measure multiple objects using various nonstandard units.

Have the student compare objects and determine if they are longer or shorter than other objects based on the number of units. For example, a stapler may measure five paperclips long while a Braille paper may measure seven paperclips long. The student should be able to determine that the stapler is shorter than the Braille paper.

Once the student demonstrates proficiency in measuring objects using nonstandard units, introduce the student to the APH Metric-English Measurement Ruler. Allow the student to explore the ruler, taking note of the measure markings and the Braille on the ruler. The student may observe that each side has different markings. Help the student focus on the English side (inches). Explain that the ruler is another way to measure the length of objects.


Demonstrate to the student how to measure the



object using the Standard English unit of an inch. Have the student place the ruler on the table with the English units on the bottom. Ask the student to begin at the left edge and locate zero, or the beginning. Have the student move along the edge reading the Braille numbers at each inch. For this lesson, have the student focus on the largest divisions of the inch.

Next, place the caliper on the ruler and explain that the caliper slide is used to make measuring easier. Focus on teaching good measurement skills such as keeping the left edge of the ruler even or flush with the object that is being measured. The caliper should be moved from the right edge to the end of the object and then used to determine the length. Provide the student with multiple examples of how to measure objects to the nearest inch beginning with guided practice and moving to independent practice.

Once the student is able to measure using the inches on the ruler, ask the student to explore the entire ruler. Ask the student how long the ruler is in inches (he should answer 12). Explain that 12 inches is equal to another standard unit called a “foot.” Explain that we use feet to measure longer distances such as the length of a classroom. Instead of a room being



120 inches, it would be 10 feet. In order to ensure understanding of comparative length, ask the student to determine which measurement would be best to use for measuring different items of various lengths. Some examples:

- Car (feet)
- Book (inches)
- Pencil (inches)
- Bus (feet)
- Distance from one classroom to another classroom (feet)
- Paperclip (inches)
- Hair (inches)
- Cell phone (inches)
- Student desk (inches or feet)
- Teacher's Desk (inches or feet)
- Tree (feet)

Connections: Read the book *Super Sand Castle Saturday* by Stuart J. Murphy. Under Larry the Lifeguard's watchful eye, three friends compete to see who can build the tallest sand castle, the deepest moat, and the longest wall. When they start to measure the results, trouble begins because each contestant uses a different nonstandard unit of measurement.

ME 1-11

Measurement

Objective: The student will compare relative temperatures of common objects or situations using nonstandard units (hot/cold, warm/warmer, cool/cooler).


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should understand how to measure using nonstandard and standard units and use repetition of a single unit to measure.

Suggested Materials:

- Objects for comparison of temperature

Strategies: The focus of this lesson should be exploring the hierarchy of relative temperature terms and using them when comparing temperatures of objects. Begin by reviewing the terms of relative temperature, including:

- Hot – Cold
- Cool – Cooler
- Warm – Warmer
- Hot – Hotter
- Cold – Colder




Provide the student with extreme examples of relative temperature. Ask the student to determine which is hot or cold:

- Coffee (or hot chocolate)
- Milk
- Ice
- Oven while in use
- Fireplace while in use
- Snow

Once the student can differentiate between extreme temperatures, explore the ideas of warm/warmer or cold/colder. Provide the student with beverages (or more simply water) that can be heated or cooled using ice or a microwave.

Extensions of this concept can be made to more real-world concepts such as:

- Is the freezer colder or hotter than the refrigerator?
- Is it hotter in the summer or in the winter?
- Is it cooler in the morning or at noon?
- Is it warmer in the desert or on an iceberg?



Connections: The understanding of relative temperature has a practical application of selecting appropriate clothing. The teacher or O&M specialist can reinforce this concept by ensuring that the student understands what clothing is appropriate in differing temperatures. Over the course of an entire school year, the teacher or O&M specialists should have opportunities to discuss the need for various types of clothing as the temperature changes.



ME 1-12

Measurement

Objective: The student will identify parts and functions of a balance scale and a talking scale.


NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should use tools to measure.

Suggested Materials:

- Balance Scale
- Objects for comparison of weight
- Talking Scale (not provided in kit)

Strategies: The student should be taught to use a balance scale in order to develop a strong understanding of weight. Begin by providing the student with the scale and allowing for exploration of the scale. Ask the student if he can determine the use of this tool.

Once the student has had ample opportunity to explore the balance scale, explain that the tool is called a “balance scale” and is used to compare the weight of objects and also to weigh objects (or see how heavy things are). Discuss the parts of



the balance scale with the student until he is able to appropriately identify the parts of the balance scale. The parts of the balance scale include:

- Two weighing pans called “scales”
- The lever bar or the “beam”
- The fulcrum, which is the v-shaped pointer that shows which scale is holding more weight.

Once the student knows the parts of the balance scale, provide the student with examples of how the balance scale is used to weigh objects. Give the student nonstandard objects to compare using the balance scale. Have the student determine which object weighs the most.

If a talking scale is available, explain the functions of the talking scale and provide the student with opportunities to weigh various objects.

Connections: The teacher or O&M specialist can also demonstrate to the student the concept of the fulcrum and balancing scales using a common see-saw found in many playgrounds. This activity can be used for the entire class as they work to balance the see-saw.

ME 1-13

Measurement

Objective: The student will estimate and measure the weight of objects using nonstandard and standard units.


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should understand how to measure using nonstandard and standard units and use repetition of a single unit to measure.

NCTM Curriculum Focal Point

Suggested Materials:

- Objects for comparison of weight
- Balance scale
- Standard Mass Set

Strategies: Begin by discussing the concept of weight (heaviness or lightness of an object). Have the student compare one object to another object to determine which is heavier. She can do this by holding each object in opposite hands at the same time or by picking up one object at a time. Once the student demonstrates the ability to compare



relative weight, provide two objects that weigh approximately the same. The student should not be able to determine which is heavier and this will provide the opportunity to discuss the purpose of scales.

Scales provide accurate measurements of how much an object weighs. Provide the student with the balance scale and review the parts and functions of the scale. Take the two objects that weighed approximately the same and place them on opposite sides of the scale. Have the student determine which object weighs more.

Explain to the student that there is another way to determine which object weighs more by using other objects. Place one of the objects in one of the scale plates (weighing pans) and then add marbles and/or paperclips to the other scale plate to measure the weight of the object. Have the student note the weight of the object in terms of the nonstandard unit (the apple weighs 10 marbles). Then have the student complete the same process with the second object and note the weight (the orange weighs 11 marbles). Then compare the objects in terms of the nonstandard units (the orange weighs one more marble than the apple). Demonstrate this concept with many different objects until the student




is able to measure objects using nonstandard units proficiently.


Next, explain to the student that we use standard units to weigh objects. In this lesson, pounds are the standard unit that should be introduced. Using the balance scale, provide the student with objects that weigh approximately one pound. Place the object on one side of the balance scale and the standard unit pound weight on the other side. Determine if the object weighs more than a pound or less than a pound. Repeat this activity with multiple objects.

It is also important that the student is able to estimate the weight of objects without using a scale. Provide the student with the pound weight so that she develops a sense of the weight of a pound. Then provide her with various objects that weigh less or more than a pound and ask the student to determine if the objects weigh more or less.

As an extension of this activity, you can also have the student actually estimate or guess how much an object will weigh in nonstandard or standard units. Having the student estimate the weight will help in the development of an idea of relative weight differences.



Connections: Independent living skills include the ability to shop and purchase goods at a grocery store. The teacher or O&M specialist can provide the student with unique opportunities to develop the ability to estimate and measure weights of objects. In the grocery store, have the student compare and estimate the number of apples that make up a pound versus the number of oranges to make up the same weight. These estimates and comparisons can be completed with a variety of items in any grocery store.



ME 1-14

Measurement

Objective: The student will estimate and measure liquid volume (or capacity) in nonstandard and standard units.


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should understand how to measure using nonstandard and standard units and use repetition of a single unit to measure.

NCTM Curriculum Focal Point

Suggested Materials:

- Measuring Cups
- Measuring Jars with caps
- Materials for comparison of volume


Strategies: Begin by providing the student with a container. Have the student determine the volume by filling the container with sand, rice, beans, or a liquid using a common cup. The student will need practice with filling a container to the top. The containers included in the kit will need to be modified with braille labels and



puff-paint or graphic art tape to determine the full line. Make sure that the student counts the number of cups as he fills the first container. Once the student has determined the number of cups or scoops needed to fill the first container, provide another container. Ask the student to explore the container and estimate if the container will need more or fewer cups or scoops than the first container he filled. Repeat this exercise with various containers until the student is able to estimate if the container will need more or less than the previous container. As an extension, it is possible with practice that the student may be able to estimate the number of cups or scoops needed to fill a container before beginning.

Once the student demonstrates the ability to determine the volume (or capacity) using nonstandard units, provide the student with the cup, pint, and quart containers. Having a cup, pint, and quart container used for milk may help to develop this concept since these items may be more recognizable to the student. Explain that these are English units used to measure volume or how much is needed to fill a container.

Using the same process, have the student fill various containers using the cup, pint, and quart containers. This exercise may be most appropriate



in a sandbox with a variety of large containers and boxes. Throughout the process, have the student estimate the volume of the objects in cups, pints, and quarts as appropriate.

As an extension, demonstrate the relationships that exist between the cup, pint, and quart. Provide the three standard unit containers and have the student determine how many cups fill a pint and then a quart. Next, have the student determine how many pints are used to fill a quart. Have the student generalize the findings:

- $2 \text{ cups} = 1 \text{ pint}$
- $2 \text{ pints} = 1 \text{ quart}$
- $4 \text{ cups} = 1 \text{ quart}$

Connections: A direct connection to measuring liquid volume can be found in simple tasks found in the kitchen. The teacher or O&M specialist should provide the student with opportunities to make different drinks that require accurate measurements. For example, the student could make lemonade using the powdered mix, water, and sugar.




Second Grade

Learning Objectives

Second Grade

- | | |
|---------|----------------------------------------------------------------------------------------------------------|
| ME 2-1 | Tell time to the nearest hour, half-hour, and quarter-hour using an analog clock. |
| ME 2-2 | Recognize the number of minutes in an hour, half-hour, and quarter-hour. |
| ME 2-3 | Determine the value of a collection of coins up to \$1.00. |
| ME 2-4* | Read and write money notation in Nemeth or UEB Code (cent [¢], dollar sign [\$], and the decimal point). |
| ME 2-5 | Determine estimates and actual costs of various items. |
| ME 2-6* | Estimate and measure the length of objects using standard units (English and metric). |
| ME 2-7 | Identify the parts and functions of a thermometer. |

- 
- ME 2-8 Estimate and measure temperature using a thermometer and compare using common descriptions such as warm, hot, cold, and cool.
- ME 2-9 Estimate and measure the weight of objects using standard units (English and metric).
- ME 2-10 Estimate and measure liquid volume (capacity) using standard units (English and metric).

*Worksheet included



Materials Suggested for Lessons

A limited number of manipulatives are included in the kit that accompanies this unit. Additionally, you may want to use the following items to add variety and to give the child more experiences with objects from his or her environment.

Braille labels, ME 2-5

Braille paper, ME 2-4

Braille-Large Print Yardstick, ME 2-6

Currency: pennies, nickels, dimes, quarters,
half-dollars, ME 2-3

Objects

for purchasing activity, ME 2-5

for comparison of length, ME 2-6

for comparison of temperature, ME 2-8

Perkins/APH Braille, ME 2-4

Talking Scale, ME 2-9

Thermometer (Tactile Demonstration), ME 2-7

ME 2-1

Measurement and Estimation

Objective: The student will tell time to the nearest hour, half-hour, and quarter-hour using an analog clock.

NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should use tools to measure.


Curriculum Focal Point

Common Core State Standards for Mathematics: 2.MD-7

Suggested Materials:

- APH Analog Clock Model
- APH Clock Face Sheets in Braille


Materials: Listed materials are only a suggestion. Feel free to substitute other appropriate materials including those from other math programs.



Strategies: Begin with the APH Analog Clock Model. Review the parts of the analog clock (hour hand, minute hand, hours, direction of movement, etc.). Review with the student how to read the hours using the hour hand. Make sure that the student is aware that the minute hand is on the 12 at the beginning of an hour. Demonstrate that as the minute hand moves, the hour hand also moves toward the next hour. However, the student needs to understand that when the hour hand is between two numbers that the hour is the lesser number.

Once the student demonstrates the ability to read the hour, review the half-hour and the minute hand. Have the student read the analog clock with the minute hand positioned on the half-hour.

Once the student demonstrates an understanding of time on the hour and the half-hour, have the student look at the entire analog clock. Explain that the half-hour splits the clock into two halves. Then, explain that the 12 hours on the clock face can also be divided into four even parts or quarters. Using the clock face, show how the 12 hours can be divided into fourths at 3, 6, 9, and 12. Explain that it is important to be able to read a clock on the quarter-hour as some activities begin or end on the quarter hour.



Using the analog clock, demonstrate how to use the minute hand to read the clock involving quarters. Provide examples such as:

- 1:15
- 3:30
- 4:45
- 8:15
- 11:15
- 6:45
- 5:15
- 10:45
- 3:15*
- 6:30*
- 9:45*
- 12:00*

*Special attention must be given to these examples as the hour and minute hands will be in close proximity.

Have the student read various times to the hour, half-hour, and quarter-hour using the APH Clock Face Sheets in Braille.

Throughout the lesson, you may want your student to read simple times. In order to do this, you will need to provide instruction on how times are written using Nemeth or UEB Code. This includes the appropriate use of the colon and the numeral and punctuation indicators and “am” and “pm”.

Examples: Nemeth

UEB

3:00

•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•

1:30 am

•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•

11:45 P.M.

Connections: The student needs to have a strong understanding of time in order to become an independent traveler. The teacher or O&M specialist should have the student read the time at the beginning of every activity. Provide the student with the estimated length of the activity and give the student the responsibility of managing time including determining when it is time to end the activity.

ME 2-2

Measurement and Estimation

Objective: The student will recognize the number of minutes in an hour, half-hour, and quarter-hour.


NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should recognize the attributes of length, volume, weight, area, and time.

Common Core State Standards for Mathematics: 2.MD-7

Suggested Materials:

- APH Analog Clock Model
- APH Clock Face Sheets in Braille


Strategies: In this lesson the student will be introduced to the concept of the minute. Begin by exploring the length of a minute. Ask the student what types of activities can be completed in a minute. Allow the student to brainstorm activities. Have the student sit without moving for an entire minute to help the student develop an understanding of the length of a minute.



Using the APH Analog Clock Model, explain to the student that the 12 at the top of the clock face is the beginning or “:00”. Explain that each number represents 5 minutes. So, the distance from 12 to 1 is 5 minutes, from 1 to 2 is another 5 minutes, from 2 to 3 is another 5 minutes, and so on. Have the student determine the number of minutes in an hour by counting by 5’s around the clock. The student should determine that there are 60 minutes in an hour. Complete the same process with the half-hour and quarter-hours. The student should understand that the hour is composed of 60 minutes, the half-hour is composed of 30 minutes, and the quarter-hour at 3 represents 15 minutes and at 9 represents 45 minutes.

Provide the student with the APH Clock Face Sheets in Braille. Using various examples ask the student to tell time to the half-hour and quarter hour. Then have the student tell the number of minutes represented in each example.

Connections: Read the book *Pigs on a Blanket: Fun with Math and Time* by Amy Axelrod. This is a comical caper with a math lesson. The scatterbrained Pig family escapes to the beach to beat the heat or tries to. Although the cool ocean is ostensibly an hour’s drive from their home, the journey takes a good deal longer, owing mostly



to Mr. Pig's endless distractions and disruptions and his decidedly dawdling nature. Use this book to help the student understand the concept of the amount of time in an hour, half-hour, and quarter hour.



ME 2-3

Measurement and Estimation

Objective: The student will determine the value of a collection of coins up to \$1.00.


NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should develop common referents for measures to make comparisons and estimates.

Common Core State Standards for Mathematics: 2.MD-8

Suggested Materials:

- Currency (pennies, nickels, dimes, quarters, and half-dollars)


Strategies: Begin by reviewing the different characteristics of each coin. It is important to review the coins to ensure that the student is able to tactually discriminate between coins. After discussing the coins, provide the student with a selection of coins and have the student sort the coins.



Review the value of each coin in terms of cents. Have the student create combinations of coins that equal other coins such as 2 nickels equal 1 dime or 2 dimes and a nickel equal a quarter.

Once the student is able to sort and determine the value of each coin, provide the student a collection of coins with a combined value of less than \$1.00. Have the student determine the value of the coins. Repeat this process until the student can efficiently and effectively determine the value of the collection of the coins. Any combination of coins would be appropriate. In general, begin with small amounts and move up as the student becomes more proficient. Some examples include:

- 1 nickel, 3 pennies = 8¢
- 1 quarter, 1 penny = 26¢
- 3 dimes, 2 nickels, 5 pennies = 45¢
- 1 quarter, 3 nickels, 15 pennies = 55¢
- 1 quarter, 7 dimes = 95¢
- 1 half-dollar, 3 pennies = 53¢
- 3 dimes, 7 nickels, 2 pennies = 67¢



Connections: Basic shopping activities that develop independent living skills can be used to reinforce the student's ability to determine the value of a collection of coins. The teacher or O&M specialist can provide the student with opportunities to use various combinations of coins to purchase goods at either vending machines or at stores.

ME 2-4

Measurement and Estimation

Objective: The student will read and write money notation in Nemeth or UEB Code (cent [¢], dollar sign [\$], and the decimal point).

NCTM Standard: Measurement for Pre-K - 2 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should select an appropriate unit and tool for the attribute being measured.

Common Core State Standards for Mathematics: 2.MD-8

Suggested Materials:

- Perkins/APH Braille
- Braille Paper

Worksheet ME 2-4

Strategies: This compensatory lesson is focused on teaching new Nemeth or UEB Code so that the student will be able to read and write money notation. The student may have already been introduced to the \$ in the literary context (dots

2,5,6) before the number symbol. For example, in a literary context (a book, newspaper, magazine, etc.), the student would read \$8.75 as ⠠⠠⠠⠠⠠⠠⠠⠠


However, in a mathematical or scientific context (math or science textbook, scientific magazine, math problems), the student would be required to read money notation in Nemeth or UEB Code.

The dollar and cent signs are the same in Nemeth or UEB Code. The decimal point differs in Nemeth to the UEB Code. The UEB numbers are in the upper cell and dropped to the lower cell for Nemeth Code numbers.

- ¢ = ⠠⠠⠠⠠⠠⠠⠠⠠ (dot 4 then dots 1,4 or "c")
- \$ = ⠠⠠⠠⠠⠠⠠⠠⠠ (dot 4 then dots 2,3,4 or "s")
- The decimal point = Nemeth: ⠠⠠⠠⠠⠠⠠⠠⠠ (dots 4,6);
UEB: ⠠⠠⠠⠠⠠⠠⠠⠠ (dots 2,5,6)

Examples:	Nemeth	UEB
• 34¢ =	⠠⠠⠠⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠⠠⠠
• \$2 =	⠠⠠⠠⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠⠠⠠
• \$8.75 =	⠠⠠⠠⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠⠠⠠
• \$0.97 =	⠠⠠⠠⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠⠠⠠
• \$0.06 =	⠠⠠⠠⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠⠠⠠

Begin by determining the student's current



understanding of money notation for literary Braille. Then, remind the student that math books use Nemeth or UEB Code and do not follow the same rules as literary Braille. The student should already understand as even basic numbers are written differently in literary and Nemeth or UEB Code. Review the money notation for the cent symbol, and introduce the dollar symbol, and the decimal point.

Provide the student with worksheet ME 2-4. Have the student read the amounts orally.

Complete worksheet ME 2-4.

Ask the student to write various money amounts beginning with the cent symbol and progressing to the dollar symbol with the decimal point.

Connections: Read the book *Follow the Money!* by Loreen Leedy. This is the story of a day in the life of a newly minted quarter, featuring George Washington sporting a rose-colored hair ribbon. The coin has quite an adventurous day; from the Federal Reserve, it makes its way to a local bank where it is picked up by a grocer for his store. The escapade continues as George ends up in such diverse places as a soda machine, piggy bank, toy store, parking meter, pet store, clothes washer, and garage sale, and finally back to the bank.



ME 2-5

Measurement and Estimation

Objective: The student will determine estimates and actual costs of various items.


NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should develop common referents for measures to make comparisons and estimates.

Common Core State Standards for Mathematics 2.MD-8

Suggested Materials:

- Objects for purchasing activity
- Braille labels


Strategies: Determining estimates and actual costs of various items should be conducted in as much of a real-world context as possible. Begin by collecting an array of items that the student would want to purchase. Add prices to each item using braille labels or develop a price list. Allow the student to explore the items.



After exploring the items, ask the student to select two items to purchase (for example, an apple for 25¢ and an orange for 29¢). Have the student estimate the cost of the two items. As a general rule, the student should round the cost of the items to the nearest 5¢. Since the apple is already at 5¢, then the student would only need to round the cost of the orange up to 30¢. For this example, the student would need to estimate 55¢ to purchase these two items. Have the student complete multiple exercises using mental math to estimate the cost of the items.

Once the student is able to estimate the cost of items, have the student complete a similar exercise and determine the actual costs of purchasing the items. The student may use an abacus or a talking calculator to check his estimates.

Create a “Class Store” where students can purchase small items with “money” earned for good behavior and academic achievements. The teacher of students with visual impairments could collaborate with the general education teacher to involve the entire class in this activity.



Connections: Providing the student with community-based instruction can help with the development of understanding estimates and actual costs. If the student is able to visit stores during lessons, the student should be provided an amount of money and determine if she can afford specific items throughout the store. Emphasis should be placed upon rounding amounts to the nearest 5¢ or even dollar for estimating.



ME 2-6

Measurement and Estimation

Objective: The student will estimate and measure the length of objects using standard units (English and metric).

NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should use tools to measure.


NCTM Curriculum Focal Point

Common Core State Standards for Mathematics: 2.MD-1,3

Suggested Materials:

- APH Metric-English Measurement Ruler with caliper
- Common objects for measuring
- Braille-Large Print Yardstick (not provided in kit)

Worksheet ME 2-6




Strategies: For this objective, instruction will focus on measurement of length using both English units (inch, foot, and yard) and metric units (centimeter and meter). As the student progresses through the lesson, teach the common abbreviations that are used to denote measurements of length:

- inch = in
- foot = ft
- yard = yd
- centimeter = cm
- meter = m

Begin by reviewing the parts of the APH Metric-English Measurement Ruler. The student will need to focus on the English side of the ruler to begin. Discuss the parts of the ruler including the left edge (the beginning or 0) and the right edge (end or 12 inches). Have the student show where each inch is on the ruler.

Next, provide the student with an object to measure that is less than 12 inches. Demonstrate to the student that the left edge must be even or flush with one edge of the object. Then have the student move the caliper to the other edge of the object and then determine the measurement




in inches. Repeat this process until the student demonstrates proficiency in measuring objects smaller than 12 inches.

Next, provide the student with an object that is longer than 12 inches (something that is 24 inches would be best). Discuss with the student that inches are small units and are difficult to use when measuring longer objects or distances. Explain that in order to measure longer distances, we use other units such as the foot. Discuss with the student that the ruler is 12 inches, but also 1 foot. Have the student use the ruler to measure the length of longer objects or distances.

Explain that for even longer distances, we use another unit called a yard. Explain that a yard is equal to three feet (lining three rulers together next to a yard stick would be appropriate). Explain that the yard is used to measure long distances such as football fields, playgrounds, backyards, rope, cloth material, etc. Have the student measure the length of a room in feet and in yards.

The student will most likely be more familiar with the English system of measurement; however, the metric system also needs to be discussed in the context of measurement. Explain that the United States is one of the few countries that uses the



English system to measure. Liberia and Myanmar are the only other countries that still use the English system of measurement. Explain that the rest of the world uses the metric system and that it is important for students in the United States to know both systems.

Provide the student with the APH Metric-English Measurement Ruler and show the metric side of the ruler. Explain that in the metric system, the centimeter (cm) is used as the basic measurement of small lengths. Likewise, the basic measurement in the metric system for long lengths is the meter (m). This is comparable to the relationship between the inch and the yard in the English system. Have the student measure the same objects he measured using the English System using the metric system. Have the student compare the different answers he obtained using the two different units of measurement.

An important concept is for the student to be able to determine which measurement unit should be used for various objects. For example, ask the student if he should use an inch, foot, or yard to measure the length of a pencil, a desk, and a football field. A similar exercise should be conducted using metric units.



Complete worksheet ME 2-6.

Connections: Read the book *Is the Blue Whale the Biggest Thing There Is?* by Robert E. Wells. The book begins on the title page with the question, “Is a Blue Whale the Biggest Thing There Is?” and answers it in a series of cumulative examples. Millions of blue whales placed into enormous jars and stacked up don’t begin to compare to the colossal size of Mt. Everest. Taking this comparison to the outer limits of the imagination, the author ends up with the biggest thing there is — the universe.

ME 2-7

Measurement and Estimation


Objective: The student will identify the parts and functions of a thermometer.

NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should use tools to measure.

Suggested Materials:

- APH Tactile Demonstration Thermometer (not provided in kit)
- Talking Thermometer


Strategies: Begin with a basic review of relative temperature (hot, hotter, cold, colder, warm, warmer, etc.). Next, ask if the student has ever listened to the news and heard the meteorologists discuss the temperatures for the next few days. Explain to the student that temperature is a way that we measure how hot or cold something is, including air. So when the meteorologist says that it is 75 degrees outside, he is saying that the air is 75 degrees. But how does he know this?



Explain that a tool called a thermometer is used to determine the temperature of many things including the air, the Thanksgiving turkey, and the human body. It is important that the student understands that the thermometer is a tool that is used in a variety of situations. Explain to the student that the function of the thermometer is to measure temperature in degrees.

Provide the student with the APH Tactile Demonstration Thermometer and explain that this is not a real thermometer. Discuss with the student that thermometers use mercury or another chemical that expands with heat. Therefore, as it gets hotter, the chemical moves upward. Thermometers have numbers on the side that help determine the actual temperature.

Present the talking thermometer to the student and allow for exploration of the tool. Explain to the student that the thermometer measures temperature with the English unit of degrees Fahrenheit. Demonstrate how the talking thermometer works using cold or hot liquids. Allow the student to determine the temperature of various items.



Connections: A thermometer is a unique tool that is used in many independent living activities such as cooking and personal healthcare. The teacher and O&M specialist can show the student where thermometers are used including the oven, the microwave, the toaster, the room thermostat, and even automobiles.

ME 2-8

Measurement and Estimation

Objective: The student will estimate and measure temperature using a thermometer and compare using common descriptions such as warm, hot, cold, and cool.


NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should use tools to measure.

Suggested Materials:

- Talking Thermometer
- Objects for comparison of temperatures

Strategies: Begin by having the student compare items using common descriptors. For example, have the student describe the temperature of Antarctica versus the Sahara Desert or the temperature of ice cream versus soup. Use concepts that are familiar to the student but are extremes.

Provide the student with various items of different temperatures and have the student estimate which items will be the warmest and coldest. Next, allow



the student to determine the temperatures of each item using the talking thermometer and have the student place the items in order from warmest to coldest.

Using the talking thermometer, provide the student with a variety of liquids that are at various temperatures. Identify the source of the water and have the student estimate the temperature of the water. Have the student measure the temperature using the thermometer and note the various temperatures. The student needs a variety of temperatures. Examples might include:

- Water with ice
- Water from the refrigerator
- Water at room temperature
- Water at outside temperature
- Hot tap water
- Water heated in the microwave oven

This activity should take place in a science laboratory or a kitchen and should be done with great care to the safety of the student.

Connections: Read the book *Hot and Cold* by Allan Fowler. The book explores the concepts of hot and cold beginning with “How hot is a hot day?”

ME 2-9

Measurement and Estimation


Objective: The student will estimate and measure the weight of objects using standard units (English and metric).

NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should use tools to measure.

Suggested Materials:

- Balance Scale
- Talking Scale (not provided in kit)

Strategies: Provide the student with the one pound weight. Then give the student a variety of objects that weigh more or less than the one pound weight and have the student compare the two using the terms heavier and lighter. Once the student demonstrates proficiency in comparing the weight to the standard of one pound have the student estimate how many pounds some of the items may weigh. Using the balance scale, have the student weigh various objects using pounds. If a talking scale is available, complete the same process using this tool.



Explain to the student that the pound is part of the English system and that the metric system has its own terms for measuring weight. Explain that the kilogram is similar to the pound but weighs more (2.2 lbs in 1 kilogram). Again, have the student compare objects to one kilogram using estimation and then use the balance scale and/or talking scale.

During the lesson explain that the abbreviation for the English pound is lb and the metric kilogram is kg. The student may ask why the lb is used for pound. Explain that lb is an abbreviation of the Roman term Libra which was a measurement of weight used during the Roman Empire.

Connections: Read the book *The Dragon Scales* by Sarah Albee. In this story a dragon takes over the bridge that leads to a town's beloved berry fields. A clever girl challenges the beast to a test of wits using balancing scales. Answering questions such as "Which weighs more, one apple or two peas?" and "Which weighs more, a little bag of gold or a big bag of cotton?" the child wins the contest. She promises to share the berries, and the creature becomes the town "watchdragon."

ME 2-10

Measurement and Estimation


Objective: The student will estimate and measure liquid volume (capacity) using standard units (English and metric).

NCTM Standard: Measurement for Pre-K - 2 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should develop common referents for measures to make comparisons and estimates.

Suggested Materials:

- Cup, pint, and quart measuring containers
- Liter measuring container

Strategies: Similar to ME 1-14, provide the student with opportunities to estimate and measure liquid volume using the English units of the cup, pint, and quart. Demonstrate how to fill a container to the top in order to determine the true volume of a container. The containers included in the kit will need to be modified with braille labels and puff-paint or graphic art tape to determine the full line. Have the student fill various containers using the measuring cup or the pint as the measuring unit. Containers could



be a cube, rectangular prism (box), cylinder, or any other container. The student needs to develop an understanding that all containers, whatever their shape, have a volume that can be measured in a smaller unit. The student should be asked to estimate the number of units needed to fill a container before measuring the volume.

The student should also be introduced to the liter, a metric unit of volume. Explain to the student that the liter is larger than a quart and is the primary unit for measuring volume in the metric system.

Have the student lead an activity where the class makes punch. Punch works best as it uses large quantities of liquids. Provide the student with a large punch bowl, measuring utensils, and the ingredients for a simple punch. For this exercise, it is important that the student estimates and actually measures the ingredients while making the punch.

Connections: Being able to measure and mix ingredients even at a large scale is an important skill. The teacher or O&M specialist should provide the student with as many opportunities to use measuring skills to make things including food (e.g., pudding, gelatin, brownies) or paint.



Third Grade






Learning Objectives

Third Grade

- ME 3-1 Tell time on an analog clock at five minute intervals.
- ME 3-2 Count and represent combined coins in dollar amounts using currency symbols (\$0.00).
- ME 3-3 Identify and count combinations of bills including one, five, ten, and twenty dollar bills.
- ME 3-4* Add and subtract amounts of money up to \$9.99 with no regrouping.
- ME 3-5 Estimate and measure the length of objects using the English system.
- ME 3-6 Estimate and measure the length of objects using the metric system.
- ME 3-7 Measure the temperature in degrees Fahrenheit using a thermometer.
- ME 3-8 Carry out simple unit conversions of English and metric units of weight (mass).



ME 3-9 Carry out simple unit conversions of English and metric units of liquid volume (capacity).

ME 3-10* The student will estimate and measure the length, liquid volume (capacity), or weight of a given object by choosing the appropriate measuring tools and units.

*Worksheet included



Materials Suggested for Lessons

A limited number of manipulatives are included in the kit that accompanies this unit. Additionally, you may want to use the following items to add variety and to give the child more experiences with objects from his or her environment.

Braille-Large Print Yardstick, ME 3-5, 3-6

Braille Paper, ME 3-4

Currency: pennies, nickels, dimes, quarters,
half-dollars, and bills ME 3-2, 3-3, 3-4

Objects

for comparison of length, ME 3-5, 3-6

Perkins/APH Braille, ME 3-4

Tablespoon - measuring, ME 3-9

Wallet, ME 3-3, 3-4

Wristwatch, Braille or talking, ME 3-1

ME 3-1

Measurement and Estimation

Objective: The student will tell time on an analog clock at five minute intervals.


NCTM Standard: Measurement for 3-5 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles.

Common Core State Standards for Mathematics: 2.MD-7

Suggested Materials:

- APH Analog Clock Model
- APH Clock Face Sheets in Braille
- Braille or Talking wristwatch (not provided in kit)


Materials: *Listed materials are only a suggestion. Feel free to substitute other appropriate materials including those from other math programs.*



Strategies: Present the APH Analog Clock Model to the student. Have the student explore the clock face and discuss what is known about the analog clock. Review the parts: hour hand, minute hand, numbers, markings, etc. Review with the student the concepts of time on the hour, half-hour, and quarter-hours.

Ask the student to begin at the 12 and rotating clockwise count around the clock face naming the numerals aloud. Explain to the student that each numeral, 1-12, represents 5 minute intervals. The distance from 12-1 is 5 minutes, from 1-2 is another 5 minutes, from 2-3 is another 5 minutes and so on. Beginning at 12, have the student count around the clock face in 5 minute intervals. Quiz the student on the number and the correlating time until the student demonstrates understanding (i.e., the numeral 4 is 20 minutes or 7 is 35 minutes). If the student has difficulty with this task, have the student count by fives for each clock face numeral.

Once the student demonstrates the ability to read the face of the analog clock, provide the student with examples of times in five minute intervals. Make sure the student again understands that the minute hand provides the minute information and the hour hand provides the hour information. Also,




remind the student that the hour hand moves slowly and may be between two numerals. To read the hour hand, always refer to the smaller number of the two. Give the student ample opportunities to demonstrate the ability to read the analog clock. Some suggested times are:

- 1:15
- 2:30
- 3:45
- 4:35
- 6:55
- 8:15
- 9:40
- 10:50
- 12:05

Have the student use the analog clock to set times at five minute intervals. For example, ask the student to show 3:45 and allow the student to move the clock hands to the correct position.

Provide the student an opportunity to practice telling time at five minute intervals using the APH Clock Face Sheets in Braille.



Complete similar activities using an analog or digital (talking) wristwatch. Review with the student how to use these devices.

Connections: The teacher and O&M specialist can connect this objective to daily routines by determining the length of various activities to the nearest five minute interval. The student could use analog or digital clocks for activities such as traveling routes, cooking, or classroom activities.

ME 3-2

Measurement and Estimation


Objective: The student will count and represent combined coins in dollar amounts using currency symbols (\$0.00).

NCTM Standard: Measurement for 3-5 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should understand the need for measuring with standard units and become familiar with standard units in the English and metric systems.

Suggested Materials:

- Currency: pennies, nickels, dimes, quarters, half-dollars

Strategies: Begin by providing the student a few sample coins to determine if he can tactually discriminate between the coins. Ask the student to describe the differences between the coins. If the student is able to differentiate between the coins, ask the student to explain the value of each coin in terms of cents. Clarify any misunderstandings of the coins and their values if needed.



Review with the student the proper Nemeth or UEB Code for the ¢, \$, and decimal point.

The dollar and cent signs are the same in Nemeth or UEB Code. The decimal point differs in Nemeth to the UEB Code. The UEB numbers are in the upper cell and dropped to the lower cell for Nemeth Code numbers.

- ¢ = ⠠⠨⠠⠠⠠ (dot 4 then dots 1,4 or "c")
- \$ = ⠠⠠⠠⠠ (dot 4 then dots 2,3,4 or "s")
- The decimal point = Nemeth: ⠠⠠ (dots 4,6);
UEB: ⠠⠠ (dots 2,5,6)

Provide the student with multiple assortments of coins and have the student determine the value. For this exercise, have the student write the answer using proper currency notation, e.g., \$2.34. Also, provide the student with unique problems involving zeroes, e.g., \$1.00, \$3.05, \$6.70, \$0.45, \$0.02, and \$0.00.

Connections: Read the book *The Coin Counting Book* by Rozanne Williams. Simple rhymes and large, clear photographs instruct children in coin denominations, grouping, and counting. Pennies, nickels, dimes, quarters and more star in this fun introduction to simple math and to the coins we carry in our pockets and purses every day.

ME 3-3

Measurement and Estimation

Objective: The student will identify and count combinations of bills including one, five, ten, and twenty dollar bills.


NCTM Standard: Measurement for 3-5 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should understand the need for measuring with standard units and become familiar with standard units in the English and metric systems.

Suggested Materials:

- Currency: bills
- Wallet

Strategies: The student may already be aware of currency in the form of bills. In this lesson the student will learn the value of bills and methods of identifying bills.

Begin by providing the student with either two rolls of pennies (50¢ each) or 4 quarters. Ask how much she has in cents (100¢). Ask the student if it would be easy to carry around 500¢, 1000¢,




2000¢, or even 10000¢ in pennies or quarters. Hopefully, the student will understand that it would be very heavy and difficult to carry.

Explain that since coins weigh so much, paper bills are used instead of coins for larger amounts of money. Discuss the different bills: \$1, \$5, \$10, \$20, \$50, and \$100. Explain that each bill represents different amounts of cents. One dollar is equal to 100¢, \$5 is equal to 500¢, \$10 is equal to 1000¢.

Since bills are all the same size, it is important to use some strategies to keep bills separated. Explain that the student should have the bank teller or cashier at the store provide the money back in sequence so that she can keep up with the bills. Practice this exercise with the student.

Provide the student with a wallet and show her how to keep the money separated. Explain that bills are commonly folded by individuals with visual impairments. A common pattern is:

- \$1 bills are not folded but placed together in the wallet
- \$5 bills are folded lengthwise (like a hotdog)
- \$10 bills are folded widthwise (like a hamburger)

- 
- \$20 bills are folded lengthwise, then widthwise. OR, \$20 bills can be folded lengthwise and placed in a different section of the wallet.

Folding money is an individual decision and any system is good as long as the person can keep up with the bills. Have the student practice folding money and placing it in the wallet. Next, practice removing specific amounts of bills. It is important to have the student remove different bills from the wallet. Give the student combinations such as \$7.00, \$13.00, \$27.00, etc.

Connections: Introduce the student to assistive technology such as OCR Scanners and software that can read bills and differentiate between bills. If these technologies are available, the student should be provided opportunities to use them to determine the denomination of the bills.

ME 3-4

Measurement and Estimation

Objective: The student will add and subtract amounts of money up to \$9.99 with no regrouping.


NCTM Standard: Measurement for 3-5 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should understand the need for measuring with standard units and become familiar with standard units in the English and metric systems.

Suggested Materials:

- Perkins/APH Braille
- Braille Paper
- Currency: coins and bills
- Teacher generated shopping list
- Wallet

Worksheet ME 3-4


Strategies: It is important that the student is able to read, write, add, and subtract amounts of money. Review with the student how to read and write dollar amounts.



Introduce the process of adding and subtracting money using a Perkins/APH Braille. Begin by having the student write a money amount with a Braille using proper Nemeth or UEB Code notation (e.g., \$6.45). Remind the student to leave a space for the operator and to skip one space on the first line. Next, have the student go to the next line and write another amount (e.g., \$1.23) including both the addition operator (plus sign) and the dollar sign. Remind the student that the decimal points should line up. Have the student add the columns, remembering to write the dollar sign and decimal point. Repeat this process with addition and subtraction problems that use amounts less than \$10 and do not require regrouping. Repeat this process with problems involving subtraction of money amounts up to \$9.99 with no regrouping.


Complete worksheet ME 3-4.

As an extension activity, provide the student with an assortment of coins and bills placed in a wallet using the money folding techniques. Explain to the student that you will be playing a game that will involve shopping. Give the student a shopping list and provide the costs of different items. Have the student purchase various combinations of items



from the list using the money in the wallet. Use the following steps:

- Have the student estimate the cost and determine if he has enough money to purchase the items. Provide situations where the student does not have enough money to purchase the items.
- Have the student determine the total cost through addition. Begin with the Braille or slate and stylus. Once the student is proficient with adding amounts of money up to \$9.99 without regrouping, allow the student to use other tools such as an abacus or talking calculator.
- Have the student select the amount of currency needed to pay for the items. Begin by allowing the student to use both bills and coins to purchase items. Once the student is proficient, only allow the student to use bills.
- Once the student is only using bills, have the student determine how much change he should receive when purchasing items. This will require the student to subtract the amounts. Again, begin with written practice and then allow the use of tools later.



Connections: The ability to add and subtract currency is an independent living skill that is used in various activities. The teacher or O&M specialist should provide the student with opportunities to shop, select, and purchase goods. The student should ensure that the correct funds are used and that the correct change is returned after the purchase.

ME 3-5

Measurement and Estimation

Objective: The student will estimate and measure the length of objects using the English system.


NCTM Standard: Measurement for 3-5 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles.

NCTM Curriculum Focal Point

Suggested Materials:

- APH Metric-English Measurement Ruler with caliper
- Objects for comparison of length
- Braille-Large Print Yardstick (not provided in kit)

Strategies: Begin by asking the student to show the length of an inch using her fingers. Provide the student with the APH Metric-English Measurement Ruler (placed with the English units




on the bottom). Allow the student to compare her understanding of an inch with the actual length.

Allow the student to explore the ruler and ask her what she knows about measurement. Ask the student to identify the length of a foot (12 inches or the entire ruler) and a yard (3 feet). Provide examples of each of these lengths such as a one-inch block, the ruler, and a yardstick so the student can compare the lengths.

Provide the student with an object to measure using the ruler and caliper. Review the process of measuring if needed. Make sure the left edge is even with one edge of the object then move the caliper from the right edge to the edge of the object. Provide the student with as many opportunities to measure objects using inches and feet/yards as possible.

It is important that the student develops a concept of relative length without using a ruler. Provide the student with objects of various lengths and have the student estimate the length of the object in inches or feet. Then have the student measure the object using the ruler and compare the measures. Continue this activity with various objects until the estimates and actual measures are similar.



When discussing the different units used in measuring length, it is important that the student understands that different units are used to measure objects or distances of different lengths. A cell phone would be measured in inches, a room in feet, a football field in yards, etc. Provide the student with various objects or distances and have the student determine which measurement unit is most appropriate.

It may also be appropriate to begin discussing the mile. Explain to the student that the mile is a unit of length that is used to measure long distances, such as the distance from one state to another state. The mile is made up of 1760 yards or 5280 feet.

Connections: Read the book *Carrie Measures Up* by Linda Aber. In this book Carrie helps her grandmother with some knitting projects by taking measurements around the house. Her assignment is so much fun that she gets carried away, and after measuring her father's feet for new slippers, she continues to collect data about such unlikely things as her mother's laptop, her dog's paws, the TV set, and even Dad's bowling ball.

ME 3-6

Measurement and Estimation

Objective: The student will estimate and measure the length of objects using the metric system.


NCTM Standard: Measurement for 3-5 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles.

NCTM Curriculum Focal Point

Suggested Materials:

- APH Metric-English Measurement Ruler
- Objects for comparison of length
- Braille-Large Print Yardstick
(not provided in kit)


Strategies: Begin by asking the student to show the length of a centimeter (cm) using his fingers. Next, provide the student with the APH Metric-English Measurement Ruler (placed with the metric units on the bottom). Allow the student to compare his understanding of a centimeter with the actual length.



Allow the student to explore the ruler and ask what the student knows about measurement. Explain that the metric system is based on the number 10 and is used in other countries and by scientists in the United States. Provide the student with examples of the length of a centimeter, decimeter ($\text{dm} = 10 \text{ cm}$), and a meter ($\text{m} = 10 \text{ decimeters}$). Meter-sticks are available in braille and are approximately 3 inches longer than a yard stick.

Provide the student with an object that the student can measure using the ruler and caliper. Review the process of measuring if needed. Make sure the left edge is even with the edge of the object then move the caliper from the right edge to the other edge of the object. Provide the student with as many opportunities to measure objects using centimeters and decimeters/meters as possible.

It is important that the student develops a concept of relative length without using a ruler. Therefore, provide the student with objects of various lengths and have the student estimate the length of the object in metric units. Then have the student measure the object using the ruler and compare the measures. Continue this activity with various objects until the estimates and actual measures are similar.



Again, when discussing the different units used in measuring length, it is important that the student understand that different units are used to measure objects or distances of different lengths. Provide the student with various objects or distances and have the student determine which measurement unit is most appropriate.

It may also be appropriate to begin discussing the kilometer. Explain to the student that the kilometer is a unit of length that is used to measure long distances, similar to the English unit of a mile. A kilometer (km) is equal to 1000 meters.

Connections: The student should be given opportunities to compare English and metric units of length in O&M lessons. Provide the student with opportunities to compare 100 yards to 100 meters. If a track is available, have the student walk a mile and compare it to the length of a kilometer.



ME 3-7

Measurement and Estimation

Objective: The student will measure the temperature in degrees Fahrenheit using a thermometer.


NCTM Standard: Measurement for 3-5 – Apply appropriate techniques, tools, and formulas to determine measurements. All students should select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles.

Suggested Materials:

- Talking Thermometer

Strategies: Begin by activating the student's prior knowledge of temperature by asking if the student is familiar with the weather report. Ask the student what information the meteorologist or the weatherman gives during his report. The student may discuss rain, sunny, snow, etc. but the intent is for the student to bring up the concept of temperature.

Discuss the different areas of life that are impacted by temperatures such as weather, cooking, indoor



comfort, drinks, the human body etc. Next, explain that you will be discussing how to use a specific tool called a thermometer to determine the temperature.

Present the talking thermometer to the student and allow for exploration of the tool. Demonstrate how to use the thermometer to measure air temperature and liquids. Explain to the student that the thermometer measures temperature with the English unit of degrees Fahrenheit. Explain that in the United States, all temperatures are recorded in Fahrenheit. Some notable temperatures include:

- 32° is the point when water freezes
- 212° is the point when water boils

Provide the student with various opportunities to measure temperature using the talking thermometer. The student, along with his class, could record the outside air temperature over a given period of 30 days. Then the student could take the information and determine the average temperature and graph the temperature using a line graph. Allow the student to measure the temperature of various liquids using the talking thermometer.

The student should also be introduced to the metric unit for measuring temperature, Celsius.


1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

As an exercise, you may want your student to write the temperature measurements throughout the lesson activities. In order for the student to do this, you will need to introduce the Nemeth or UEB Code for the “degree” symbol which is a unique symbol. To write degrees in Nemeth, the student would write the numeral (using the numeral indicator) followed by a superscript indicator (dot 4-5) followed by the two cell symbol for degree (dot 4-6 and dot 1-6). In UEB, the degree symbol is (dot 4-5 and dot 2-4-5).

Examples:	Nemeth	UEB
59°		
32° F = 0° C		

UEB

Figure 1 displays 12 dot patterns arranged in a 2x6 grid. Each pattern is a unique configuration of black dots on a white background. The patterns are labeled with numbers 1 through 12 in a small font below each grid.



Connections: The mathematical concept of temperature is used in many daily living skills. Review events that will require the student to know and use accurate measurements of temperature such as setting the oven to bake cookies, setting the thermostat in the home, and taking body temperature when someone is ill.



ME 3-8

Measurement and Estimation


Objective: The student will carry out simple unit conversions of English and metric units of weight (mass).

NCTM Standard: Measurement for 3-5 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should carry out simple unit conversions, such as from centimeters to meters, within a system of measurement.

Suggested Materials:

- Balance Scale
- Standard Mass Set – English weights
- Kilogram Mass – Metric weights
- Hexagram Weights – Metric weights

Strategies: Review with the student the units used in English and metric systems to measure weight (or mass) and how to use the balance scales. (Always test the balance beam before use to make sure that it is calibrated to give a correct weight.) Place the 1 pound weight in one scale (weighing pan) and ask the student to add ounces to the other scale until the scales are even.



Explain that ounces are a smaller measure of weight in the English system. The student should determine that 16 ounces equal one pound. Next, ask the student to make these simple conversions using the 16:1 ratio of ounces to pounds:

- Determine how many ounces make up 2 lbs
- Determine how many ounces make up 3 lbs
- Determine how many ounces make up 5 lbs
- Determine how many pounds are in 32 oz
- Determine how many pounds are in 128 oz
- Determine how many ounces make up 2.5 lbs (for advanced students)

Develop problems that are appropriate for the individual student's ability to multiply and divide. For advanced students, you can also introduce the concept of the ton ($T = 2000$ lbs). Explain that the ton is used to measure very heavy objects such as cars, trucks, etc. Provide the student with problems converting tons into pounds and vice versa. Ask the student how many pounds are in 3 T or how many tons can be made from 10,000 lbs?

Once the student is able to complete unit conversions with English units, review the metric units of weight. When using the hexagram weight set, discuss the differences in weight as they




correlate with the thickness of the weight. The most used metric units of weight are:

- Milligrams (mg)
- Grams (g) = 1000 mg
- Kilograms (kg) = 1000 g
- Metric ton (t) = 1000 kg

Provide the student opportunities to weigh various objects using the metric weights and the balance scale. Have the student complete conversions using the metric units as appropriate to the student's ability. Examples might include:

- Determine how many milligrams are in 5 grams
- Determine how many grams are in 3 kg
- Determine how many kg are in 4 t
- Determine how many mg are in 1 kg
- Determine how many grams are in 2.5 kg*
- Determine how many mg are in 1.3 g*
- Determine how many kg are in 3.5 t*

*Problems for more advanced students



Connections: The concept of weight as a measurement is often used in science. Gravity can be explained in terms of weight. Have the student determine his weight on the moon. With less gravitational pull, a person standing on the moon weighs only 16.5% of what they would weigh on earth. Therefore, a man who weighs 150 lbs would weigh 24.75 lbs ($150 \times .165$).



ME 3-9

Measurement and Estimation

Objective: The student will carry out simple unit conversions of English and metric units of liquid volume (capacity).


NCTM Standard: Measurement for 3-5 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should carry out simple unit conversions, such as from centimeters to meters, within a system of measurement.

Common Core State Standards for Mathematics: 3.MD-2

Suggested Materials:

- Measuring cups
- Measuring jars with caps
- Tablespoon - measuring (not provided in kit)

Strategies: Begin by providing the student with the following liquid volume measuring tools: a tablespoon, fluid ounce ($\frac{1}{8}$ c), cup, pint, quart, and a gallon. Have the student fill each container using the smaller unit to fill the next largest unit, such as using tablespoons to measure a




fluid ounce. Review with the student how to fill a container to the full line. The containers included in the kit will need to be modified with braille labels and puff-paint or graphic art tape to mark the full line.

Have the student keep up with the connections between each unit. In the end, the student should have an understanding of the following measurement relationships/ratios:

- 2 tablespoons (tbsp) = 1 fluid ounce (fl oz)
- 8 fluid ounces (fl oz) = 1 cup (c)
- 2 cups (c) = 1 pint (pt)
- 2 pints (pt) = 1 quart (qt)
- 4 quarts (qt) = 1 gallon (gal)

Next, have the student complete conversions using the above mentioned ratios. Sample problems include:

- How many fluid ounces are in 2 cups?
- How many cups are in 3 pints?
- How many pints are in 5 quarts?
- How many quarts are in 5 gallons?
- How many cups are in 1 gallon? *
- How many pints are in 1 gallon? *
- How many fluid ounces are in 1 gallon? *



*For advanced students who have the appropriate problem solving skills. These are more challenging because they require multiple conversions.

In a similar fashion, provide the student with the metric unit containers and have the student develop the ratios of conversion. Findings might include:

- $1000 \text{ ml} = 1 \text{ l}$
- $2500 \text{ ml} = 2.5 \text{ l}$
- $500 \text{ ml} = 0.5 \text{ l}$
- $3372 \text{ ml} = 3.372 \text{ l}$

Have the student complete conversions using this basic metric ratio.

Connections: Read the book *Millions to Measure* by David M. Schwartz. This book not only manages to impart a good deal of basic information about linear, weight, and volume measurements but also entertains the reader.

ME 3-10

Measurement and Estimation

Objective: The student will estimate and measure the length, liquid volume (capacity), or weight of a given object by choosing the appropriate measuring tools and units.

NCTM Standard: Measurement for 3-5 – Understand measurable attributes of objects and the units, systems, and processes of measurement. All students should carry out simple unit conversions, such as centimeters to meters, within a system of measurement.

NCTM Curriculum Focal Point


Common Core State Standards for Mathematics: 3.MD-2

Suggested Materials:

- Appropriate measuring tools

Worksheet ME 3-10

Strategies: The purpose of this objective is to have the student determine which type of measurement, the unit of measure, and the appropriate tool to be used given specific situations.



Provide a review of the basic types of measurement: length, volume (capacity), weight, time, and temperature. Ask the student what units are used with each:

- Length:
 - English (inch, foot, yard, mile)
 - Metric (millimeter, centimeter, meter, kilometer)
 - Tool: Ruler, Measuring tape
- Liquid Volume:
 - English (tablespoons, fluid ounces, cups, pints, quarts, gallons)
 - Metric (milliliters, liters)
 - Tool: Graduated containers
- Weight:
 - English (ounces, pounds, tons)
 - Metric (milligram, gram, kilogram, metric ton)
 - Tools: Balance scales, scales
- Time:
 - Hours and minutes
 - Days, weeks, months, years
 - Tools: Analog and digital clocks, calendars

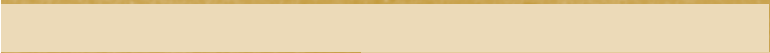
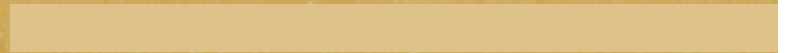
- Temperature:
 - English (Fahrenheit)
 - Metric (Celsius)
 - Tool: Thermometer

Quiz the student with specific questions that focus on having the student determine the best measurement unit and tool to use. For example, ask the student how to determine how cold it is outside (answer: thermometer to determine the temperature in degrees Fahrenheit or Celsius).

Complete worksheet ME 3-10.

Connections: Read the book *How Tall, How Short, How Far Away?* by David Adler. The book begins with a lively discussion of the history of measurement that incorporates some hands-on activities. Students learn that in ancient Egypt, parts of the body were used as measuring tools; a digit was the width of one finger, and a palm was the width of four fingers. Explanations progress from Egyptian methods to the English (or inch-pound) to the metric system.

Assessment Check List



Objective	Date/Rating Notes
Kindergarten	
ME K-1 Demonstrate an understanding of the periods of a day (morning, afternoon, evening, night) and common activities associated with each.	
ME K-2 Demonstrate an understanding of the concepts of time as it relates to day sequence (today, yesterday, and tomorrow).	
ME K-3 Recognize and compare attributes of time by comparing events according to duration (more time than, less time than).	
ME K-4 Demonstrate awareness of relative lengths of time (minute, hour, day, week, month, and year).	
ME K-5 Identify coins and their value based upon physical attributes.	


ME K-6 Compare the length of objects by making direct comparisons with reference objects using nonstandard units (longer, shorter, or equal).	
ME K-7 Compare relative weight of common objects using nonstandard units (heavier, heaviest, lightest, same as).	
ME K-8 Compare relative liquid volume (capacity) of containers using nonstandard units (more, less, same as).	

Use the following rating scale to indicate the student's current level of performance of each objective:

- 1 = Beginning level of performance
- 2 = Developing level of performance
- 3 = Accomplished/Mastery level of performance

Objective	Date/Rating Notes
First Grade	
ME 1-1 Identify parts and functions of an analog (conventional) clock.	
ME 1-2 Tell time to the hour using an analog clock.	
ME 1-3 Tell time to the half-hour using an analog clock.	
ME 1-4 Name the days of the week and the months of the year in sequence.	
ME 1-5 Use a calendar to identify dates including the days of the week and months of the year.	
ME 1-6 Identify and order coins with respect to value: penny, nickel, dime, quarter, and half-dollar.	

ME 1-7 Identify equivalency relationships between coins and show different combinations of coins that equal the same value.	
ME 1-8 Read and write money notation of cents (¢) in Nemeth or UEB Code.	
ME 1-9 Solve real-world problems related to cost and purchasing of items.	
ME 1-10 Compare and measure the length of objects using nonstandard and standard units.	
ME 1-11 Compare relative temperatures of common objects or situations using nonstandard units (hot/cold, warm/warmer, cool/cooler).	
ME 1-12 Identify parts and functions of a balance scale and a talking scale.	
ME 1-13 Estimate and measure the weight of objects using nonstandard and standard units.	



ME 1-14 Estimate and measure liquid volume (or capacity) in nonstandard and standard units.	
---------------------------------------------------------------------------------------------	--

Use the following rating scale to indicate the student's current level of performance of each objective:

- 1 = Beginning level of performance
- 2 = Developing level of performance
- 3 = Accomplished/Mastery level of performance

Objective	Date/Rating Notes
Second Grade	
ME 2-1 Tell time to the nearest hour, half-hour, and quarter-hour using an analog clock.	
ME 2-2 Recognize the number of minutes in an hour, half-hour, and quarter-hour.	
ME 2-3 Determine the value of a collection of coins up to \$1.00.	
ME 2-4 Read and write money notation in Nemeth or UEB Code (cent [¢], dollar sign [\$], and the decimal point).	
ME 2-5 Determine estimates and actual costs of various items.	
ME 2-6 Estimate and measure the length of objects using standard units (English and metric).	
ME 2-7 Identify the parts and functions of a thermometer.	

ME 2-8 Estimate and measure temperature using a thermometer and compare using common descriptions such as warm, hot, cold, and cool.	
ME 2-9 Estimate and measure the weight of objects using standard units (English and metric).	
ME 2-10 Estimate and measure liquid volume (capacity) using standard units (English and metric).	

Use the following rating scale to indicate the student's current level of performance of each objective:

- 1 = Beginning level of performance
- 2 = Developing level of performance
- 3 = Accomplished/Mastery level of performance

Objective	Date/Rating Notes
Third Grade	
ME 3-1 Tell time on an analog clock at five minute intervals.	
ME 3-2 Count and represent combined coins in dollar amounts using currency symbols (\$0.00).	
ME 3-3 Identify and count combinations of bills including one, five, ten, and twenty dollar bills.	
ME 3-4 Add and subtract amounts of money up to \$9.99 with no regrouping.	
ME 3-5 Estimate and measure the length of objects using the English system.	
ME 3-6 Estimate and measure the length of objects using the metric system.	

ME 3-7 Measure the temperature in degrees Fahrenheit using a thermometer.	
ME 3-8 Carry out simple unit conversions of English and metric units of weight (mass).	
ME 3-9 Carry out simple unit conversions of English and metric units of liquid volume (capacity).	
ME 3-10 The student will estimate and measure the length, liquid volume (capacity), or weight of a given object by choosing the appropriate measuring tools and units.	

Use the following rating scale to indicate the student's current level of performance of each objective:

- 1 = Beginning level of performance
- 2 = Developing level of performance
- 3 = Accomplished/Mastery level of performance



Appendix A



Appendix A

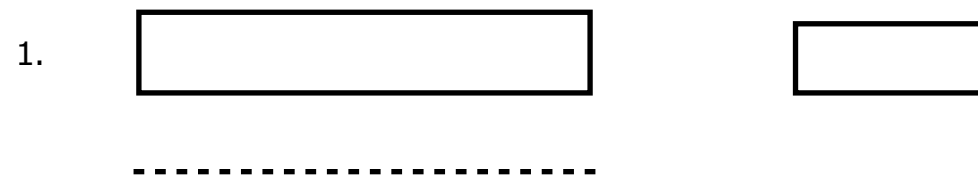
Related Math Materials available from the American Printing House for the Blind

<u>APH Products</u>	<u>Catalog #</u>
1-Foot Braille Rulers	1-03070-00
Analog Clock Model	1-03125-00
Chang Tactual Diagram Kit	1-03130-00
Classroom Calendar Kit	1-18970-00
Clock Face Sheets in Braille	1-03111-00
Consumable Number Lines: Braille	1-03013-00
Consumable Number Lines:	
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Thermometer	1-03020-00
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Answer Key for Worksheets

ME K-6 Measurement and Estimation (1 of 2 sheets)
Mark the shape that is longer.

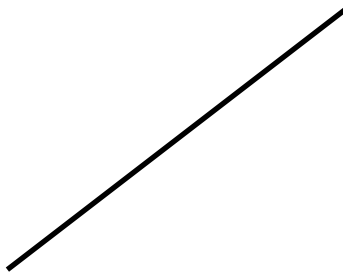
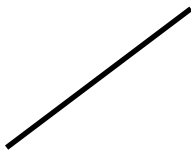


ME K-6 Measurement and Estimation (2 of 2 sheets)
Mark the shape that is longer.

4.



5.



ME 1-8 Measurement and Estimation
Read the problems orally.

1. 1¢
2. 5¢
3. 10¢
4. 25¢
5. 50¢
6. 12¢
7. 49¢
8. 54¢
9. 37¢
10. 79¢
11. 99¢
12. 83¢
13. 11¢
14. 8¢
15. 95¢

ME 2-4 Measurement and Estimation
Read the problems orally.

1. 25¢
2. 99¢
3. \$5
4. \$1.99
5. \$12.37
6. \$6.95
7. \$2.00
8. \$0.99
9. \$15.95
10. 89¢
11. \$28.76
12. \$20
13. \$0.25
14. \$7.95
15. \$77.42
16. \$23.00
17. \$89.90
18. \$191.91
19. 33¢
20. \$1000

ME 2-6 Measurement and Estimation (1 of 2 sheets)

Estimate the length of the object then measure the object using a ruler with a caliper.

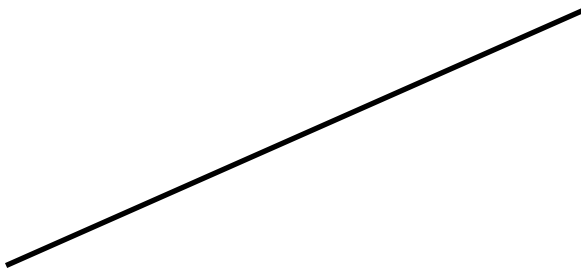
1.



2.



3.



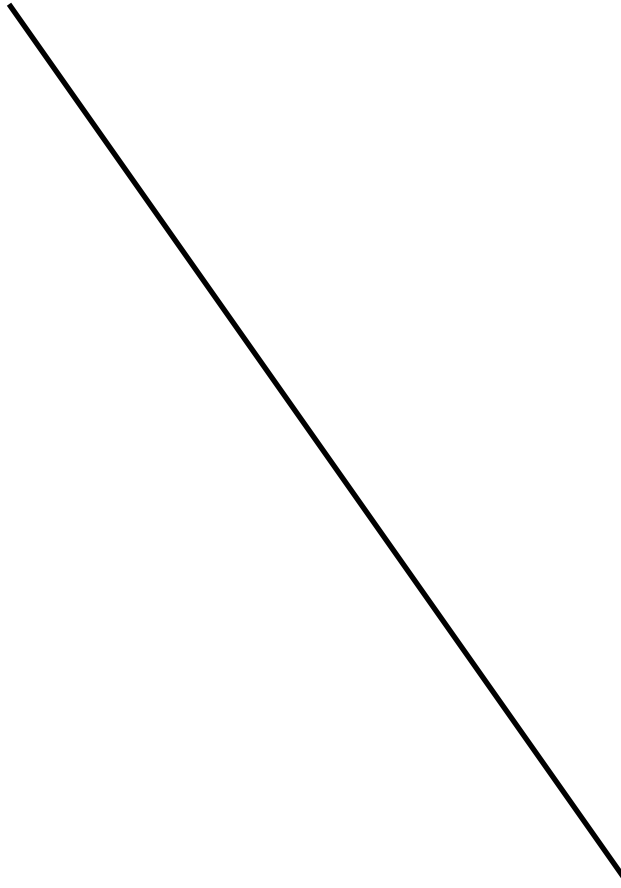
ME 2-6 Measurement and Estimation (2 of 2 sheets)

Estimate the length of the object then measure the object using a ruler with a caliper.

4.



5.



ME 3-4 Measurement and Estimation
Solve the problems.

1. $5\text{¢} + 10\text{¢} = 15\text{¢}$
2. $18\text{¢} + 31\text{¢} = 49\text{¢}$
3. $35\text{¢} - 22\text{¢} = 13\text{¢}$
4. $\$5 + \$4 = \$9$
5. $\$10 - \$3 = \$7$
6. $\$25.00 + \$12.00 = \$37.00$
7. $\$18.99 + \$1.00 = \$19.99$
8. $\$25.25 + \$50.50 = \$75.75$
9. $\$12.00 - \$8.00 = \$4.00$
10. $\$55.30 - \$23.15 = \$32.15$
11. $\$9.95 - \$2.95 = \$7.00$
12. $\$19.95 + \$1.99 = \$21.94$
13. $\$20 - \$5.50 = \$14.50$
14. $\$54.79 - \$12.53 = \$42.26$
15. $\$10.00 - \$0.25 = \$9.75$
16. $\$100 + \$200 = \$300$
17. $\$9.99 - \$2.33 = \$7.66$
18. $\$3.23 - \$1.23 = \$2.00$
19. $\$0.68 - \$0.33 = \$0.35$
20. $\$100 - \$0.01 = \$99.99$

ME 3-10 Measurement and Estimation (1 of 2 sheets)

Read the problem. Then determine what measure and measurement tool would be used to complete the problem.

1. Mandy wants to know if she needs to wear a heavy coat to school today. What does she need to do? (temperature – thermometer)
2. John wonders how far it is from his house to his school. How can he measure to find the answer? (miles or kilometers – odometer or pedometer)
3. Darla is going to make a cake for her mother's birthday. What measuring tool(s) and measure(s) will she use to mix the cake? (cups, tablespoon, teaspoon – measuring cups and spoons)
4. Peter needs to carry his book bag to school. How can he determine how much the bag weighs? (pounds and ounces or kilograms and grams – scales)
5. Melissa wants to put her pictures in picture frames, but she is not sure they will fit. What measuring tool(s) and measure(s) would she use to make sure the pictures fit? (inches or centimeters – ruler)

ME 3-10 Measurement and Estimation (2 of 2 sheets)

Read the problem. Then determine what measure and measurement tool would be used to complete the problem.

6. Matt is getting ready to run in a race and he wants to know the length of one lap on the track. What measuring tool(s) and measure(s) could he use to answer his question? (yards or meters – yardstick or meterstick)
7. Ruth is making lemonade to sell at her lemonade stand. What measuring tool(s) and measure(s) might she use to help make the lemonade? (cups, quarts or liters and milliliters – measuring cups and measuring pitchers)
8. Billy wants to know how much his dog Lexie weighs. What measuring tool(s) and measure(s) could he use to answer his question? (pounds and ounces or kilograms and grams – scales)
9. Samantha wants to know distance from her room to the kitchen. What measuring tool(s) and measure(s) could she use to answer this question? (yards, feet, and inches or meters and centimeters – yardstick or meterstick)
10. Paul wants to know how much an elephant weighs. What is the most appropriate measure to use? (tons and pounds or metric ton and kilograms – scales)

Response	Percentage
Not responsible	25%
Responsible	75%
Don't know	10%
Other	10%

[illegible]



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