Measurement

Activity Set 3

Trainer Guide

MEASUREMENT
ACTIVITY SET #3

NGSSS 5.G.5.2

A Lengthy Story

During this activity participants explore various properties of length, including appropriate units, benchmarks, conversions, and problem-solving applications. Participants consider ways to support student understanding of these concepts.

OBJECTIVES

- Identify units of length.
- Identify benchmarks for units of length.
- Convert units of length within a system (inches/feet, centimeters/meters).
- Add and subtract units of length.

MATERIALS

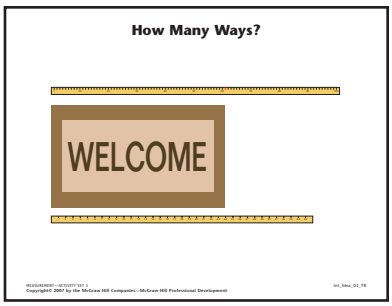
- *Transparency/Page: How Many Ways?*
- *Transparency/Page: Length Equivalencies*
- *Transparency/Page: Conversion Formulas*
- *Transparency/Page: Garden Design Project*
- *Transparency/Page: Project Planning*
- Blank transparencies
- overhead pens
- chart paper
- markers, colored pencils, or crayons
- grid paper (centimeter and/or inch)

VOCABULARY

- benchmark
- millimeter

TIME: 45–60 minutes

Teaching Tip: Groups will need three or four copies each of grid paper for the problem-solving activity. Gather these in advance and distribute, as needed.



Transparency: How Many Ways?

INTRODUCE

- Display *Transparency: How Many Ways*? and distribute the matching pages.
- Explain that today's activities will focus on the attributes of length.
- Have participants move into groups of three or four.
- Distribute a piece of chart paper and a marker to each group.
- Have each group describe the width of the welcome mat in as many mathematical ways as they are able and record their descriptions on their chart paper.
- Give the groups 5 minutes to complete the activity.
- Call the groups together.
- Ask a volunteer from each group to come to the front and share its list.
- Have the group discuss the reasonableness of each description (e.g., how meaningful and understandable the description is).
- Circle or highlight each unique description. For example, if one group listed the length as 1 foot 12 inches and no other group listed that description, it would be considered unique.
- Suggest that by the time students reach third grade, they should have had many experiences measuring the length of objects, in both nonstandard and standard units, especially in inches and feet.
- Note that the importance of students being able to use rulers skillfully when working on tasks such as the one just completed, which could have been done using an actual mat rather than a picture.
- Suggest that being able to use rulers with precision is not a skill they should assume students have and that they should provide a variety of activities to refresh students' understanding of and skill with rulers. For example, they should verify that students are able to find lengths both by aligning objects with the zero point on a ruler or aligning it with other points that would involve the use of computation or counting on to find actual object length.

- Point out that many hands-on activities will help students in the intermediate grades learn to think flexibly about units of length, as participants were asked to do during the *How Many Ways?* activity.
- Emphasize that as students advance through the grades, their experiences with length grow more complex—they are expected to use more metric measurements and to measure with greater precision.
- Point out that students in these grades also are expected to convert between units within a system and to add and subtract lengths in problem-solving situations.
- Mention that many of them were converting, for example, between feet and inches in the *How Many Ways?* activity.

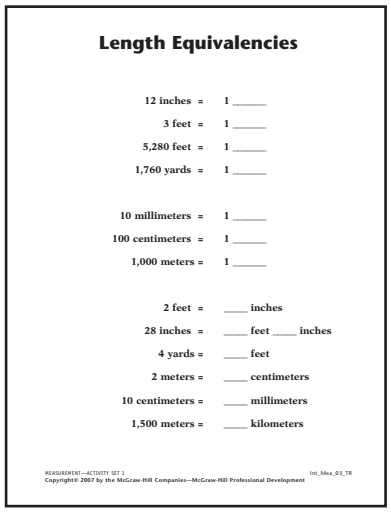
Teaching Tip: If time permits, you may have participants revisit their *How Many Ways?* charts throughout the session to add additional length descriptions as they think of them.

DISCUSS AND DO

- Display a blank transparency and use an overhead pen to label it "Units of Length".
- Ask participants to name standard units (both customary and Metric) that can be used to measure length.
- Record, on the left side of the transparency, each unit named. If participants do not mention them, include:
  - inch
  - foot
  - yard
  - mile
  - millimeter

  - centimeter
  - meter
  - kilometer
- Rewrite the units on the right column, grouped as customary and metric units and in order of size (as shown in previous list).
- Discuss with participants the use of benchmarks—items to help students understand the relative size of each unit of measure.
- Explain that an important element of good number or measurement sense is to have a good understanding of benchmarks for each single unit of length.
- Explain that benchmarks, or referents, are used to help students make reasonable estimates, help them verify or validate the results of measurement tasks, and help them develop a level of comfort with the various units of measure.
- Point out that as students make conversions between units of length, having good benchmarks can help them determine the reasonableness of their responses.
- Have participants work in groups of three or four.
- Distribute chart paper and markers to each group.
- Have each group generate a list of benchmarks that can be used for each unit of measure shown on the displayed transparency. For example, a group may suggest that the length of a finger between knuckles is an appropriate benchmark for 1 inch.
- Give participants 5 minutes to complete the activity.
- Call the groups together.
- Have all the groups post their charts.
- Discuss the benchmarks listed.
- Point out any repeated or unique benchmarks.
- Remind participants that benchmarks should be meaningful to each individual.

- Point out, if they are not listed, some common estimation benchmarks:
  - inch: the length between the first and second knuckle on a person's first finger
  - foot: the length from a person's elbow to their palm, or two feet placed end to end
  - yard: a pace, or a wide step
  - millimeter: the thickness of a dime.
  - centimeter: the width of a finger
  - meter: a bit longer than a yard, or the height from the floor to a person's hip
- Ask participants if some units of length were more difficult to come up with a benchmark.
- Mention that very small and very large units are often difficult to benchmark.
- Suggest that if these measures were difficult for them, they are probably even more difficult for students.
- Suggest that they may want to work for extensive periods of time to ensure that students have a clear sense of the meaning for each unit of measure.
- Suggest to students that such activities are ideal for cooperative group work, as group members will benefit from the shared knowledge and experiences of other members.
- Display *Transparency: Length Equivalencies* and distribute the matching pages.
- Discuss with participants the importance of students in grades 3–5 having a sense of common length unit equivalencies.
- Ask participants to provide missing values for each equation.
- Point out to participants that after numerous meaningful experiences with length, that most of the equivalency relationships are internalized. Explain that this may be true for most participants but will likely not be the case for all students.



Length Equivalencies

12 inches = 1 _____
3 feet = 1 _____
5,280 feet = 1 _____
1,760 yards = 1 _____

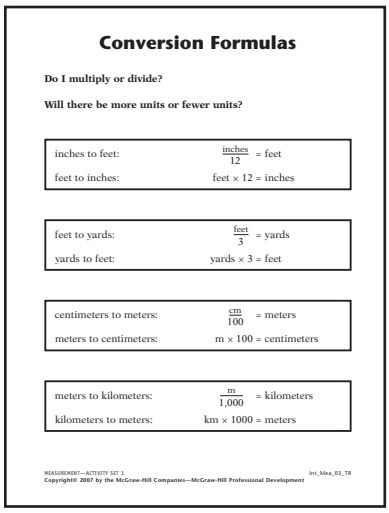
10 millimeters = 1 _____
100 centimeters = 1 _____
1,000 meters = 1 _____

2 feet = ____ inches
28 inches = ____ feet ____ inches
4 yards = ____ feet
2 meters = ____ centimeters
10 centimeters = ____ millimeters
1,500 meters = ____ kilometers

MEASUREMENT—ACTIVITY SET 3 Int_Mea_03_TR

Transparency: Length Equivalencies

MEASUREMENT
ACTIVITY SET #3



Conversion Formulas

Do I multiply or divide?

Will there be more units or fewer units?

inches to feet:	$\frac{\text{inches}}{12}$ = feet
feet to inches:	feet × 12 = inches

feet to yards:	$\frac{\text{feet}}{3}$ = yards
yards to feet:	yards × 3 = feet

centimeters to meters:	$\frac{\text{cm}}{100}$ = meters
meters to centimeters:	m × 100 = centimeters

meters to kilometers:	$\frac{\text{m}}{1{,}000}$ = kilometers
kilometers to meters:	km × 1000 = meters

MEASUREMENT—ACTIVITY SET 3 Int_Mea_03_TR

Transparency: Conversions Formulas

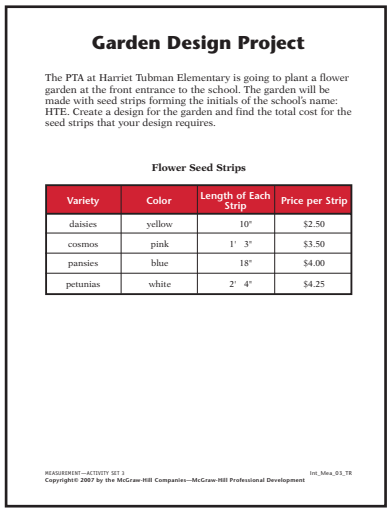
- Display *Transparency: Conversions Formulas* and distribute the matching pages.
- Discuss with participants that many students in the middle elementary grades will be expected to make conversions between units in a system, such as inches to feet, or centimeters to meters.

  Note that students in middle elementary grades are rarely, if ever, expected to make precise conversions between systems (e.g., inches to centimeters). It is important, however, that students have a general sense of the approximate relationships (e.g., a meter is a little longer than a yard).
- Suggest to participants that students may have trouble deciding when to multiply and when to divide when making a unit conversion.
- Suggest that the question "Will I get fewer units or more units after converting?" can be used to help them decide between operations. If they are going from a smaller unit to a larger one, thus having fewer units, they will divide. If they are going from a larger unit to a smaller one, thus having more units, they will multiply.
- Model for participants some sample guiding questions.
  - If I convert 52 inches to feet, will I end up with more units or fewer units? Why?
  - If I convert 5 yards to feet, will I end up with more units or fewer units? Why?
  - To convert feet to inches, do I multiply or divide? Why?
  - To convert meters to centimeters, am I moving from a larger unit to a smaller unit or from a smaller unit to a larger unit?
  - I converted 4 feet to 12 yards. Is this reasonable?
- Point out the use of "Why?" as part of some of the questions.
- Explain that it is important for students to understand and to articulate why they select a particular response.

- Go over each conversion equation with participants, pointing out the change, many to fewer and fewer to many.
- Point out to participants how straightforward the metric unit conversions are compared to customary units.
- Explain that because the metric measurement system is based on powers of ten, the conversions are relatively easy. This is in contrast to the customary system in which a wide variety of conversion factors are applied.
- Suggest to participants that having students make unit conversions in isolation, or without context, is not meaningful, nor advisable. Rather, unit conversions should be developed in problem-solving applications, within a meaningful context.
- Ask participants to identify some real-life examples in which people or students might need to convert between units of length. Some examples may include:
  - converting feet to yards or yards to feet when working with fabric
  - converting feet to inches when selecting floor, counter, or bathroom tiles
- Suggest that the use of application situations does not in any way mean that practice activities are inappropriate, only that they should follow conceptual understanding.
- Discuss one or two exercises that can support student facility with the conversion process.
  - 3rd grade: Connect length conversion activities to multiplication and multiplicative patterns. Have students create a table that lists feet and yard equivalents in multiples of threes (3 feet = 1 yard, 6 feet = 2 yards, 9 feet = 3 yards, etc.). Similar tables can be created for inches: feet and multiples of 12; or for millimeters: centimeters and multiples of 10.

- 5th grade: For students who are proficient with and thoroughly understand decimal concepts, discuss decimal place value as it relates to metric conversions. For example, to convert 10,000 meters to kilometers, you simply move the decimal point to the left 3 places (the equivalent of dividing by 1,000), resulting in 10 kilometers.

- Have participants suggest other practice activities or processes that can be used to help students understand conversions between units of length in the intermediate grades.
- Remind participants that the techniques and units you have discussed do not make an exhaustive list but that they are the most common ones students in middle elementary grades will be expected to make.
- Explain to participants that they will now explore the use of unit conversions in a problem-solving situation.
- Have participants move back into small groups.
- Display *Transparency: Garden Design Project* on the overhead projector.
- Distribute *Page: Garden Design Project*, *Page: Project Planning*, and grid paper to each participant.
- Go over the directions on the project sheet, explaining that participants may use the grid paper to plan their designs. (If participants are not familiar with these seed strips, explain that many nurseries and seed supply companies now sell flower seeds that have been embedded in long strips of biodegradable paper.)
- Display *Transparency: Project Planning*.
- Explain to participants that part of the task is to complete the Project Planning page, showing their work and explaining each step.
- Point out that the use of grid paper implies the use of scale and that understanding scale would therefore be a prerequisite skill for the activity.



Garden Design Project

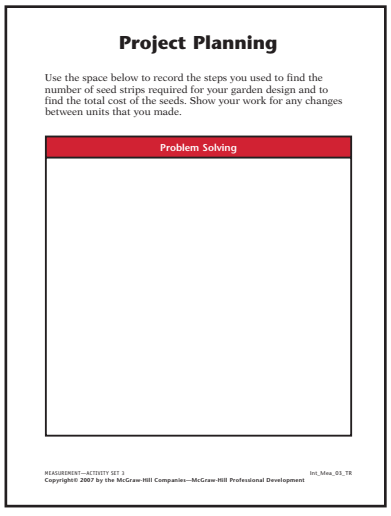
The PTA at Harriet Tubman Elementary is going to plant a flower garden at the front entrance to the school. The garden will be made with seed strips forming the initials of the school's name: HTE. Create a design for the garden and find the total cost for the seed strips that your design requires.

Flower Seed Strips

Variety	Color	Length of Each Strip	Price per Strip
daisies	yellow	10"	$2.50
cosmos	pink	1' 3"	$3.50
pansies	blue	18"	$4.00
petunias	white	2' 4"	$4.25

MEASUREMENT—ACTIVITY SET 3 Int_Mea_03_TR

Transparency: Garden Design Project



Project Planning

Use the space below to record the steps you used to find the number of seed strips required for your garden design and to find the total cost of the seeds. Show your work for any changes between units that you made.

Problem Solving

MEASUREMENT—ACTIVITY SET 3 Int_Mea_03_TR

Transparency: Project Planning

- Discuss with participants several scales that would be appropriate for this task, suggesting that they may choose to work with scale appropriate to the grades they teach. Some sample scales include:
  - 1" : 1"— each inch on paper represents 1 inch in the design
  - 1" : 2"—1 inch on grid paper = 2 inches in the design
  - 1" : 1' —1 inch = 1 foot in the design
- Point out to participants that a more advanced scale increases the steps in the activity and involves more conversion between units. Such tasks, which can also involve the use of simple ratios, would be most appropriate for students in the upper-intermediate grades.
- Suggest that the group part of a similar activity with lower-grade students could stop with finding the total length needed for each kind of strip. Then, finding the cost of one or more of the designs could be modeled by the teacher and completed as guided practice for the entire class.
- Remind participants that the cost for the strips should include the entire length of all strips. For example, if one letter required 4 whole strips plus 3 inches more, 5 strips would need to be purchased.
- Give participants 10–15 minutes to complete this activity.
- Circulate to answer questions as people work.
- Suggest to participants that were they to do this activity in the classroom, they would be moving around the room to observe and correct work in progress.
- Call the groups together.
- Have a volunteer from each group share its design and the process participants used to complete the task.

- Point out to participants that this kind of sharing time is important for students. It not only motivates them to do good work, it allows them to hear the problem-solving strategies and approaches used by others to complete multistep activities.
- Emphasize that students benefit greatly from exposure to a variety of approaches and techniques.
- Discuss with participants the various degrees of precision that could be used for the measurements for this activity (or a similar activity) if it was conducted in real life.
- Explain that it is important to discuss with students circumstances in which measurements need to be precise and ones in which measurements can be less precise.

Teaching Tip: If time permits, discuss with participants the related story problems that could be created and solved along with this or a similar activity. For example:

- The seed strips needed for the letter "H" were 10", 8", and 11". Is a seed strip that is 2' 4" long enough? If it is long enough, would there be any extra? If it is not long enough, how much more seed strip is needed?
- How much longer are the strips needed for the letter H than for the letter L?

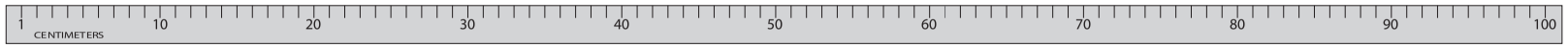
CONCLUDE

- Point out to participants that completing the design task required them to use a variety of length concepts and skills.
- Point out that interesting problems in which students need to apply a variety of skills can be quite engaging and can help students strengthen and reinforce their knowledge of length concepts.

- Point out that similar activities can also be used as alternative assessments to help them monitor student understanding and identify any misconceptions or gaps in knowledge.
- Remind participants that even though many grade 3–5 measurement activities may involve problem-solving applications that include operations with units of length, students at these grade levels should still have many hands-on experiences with length.
- Suggest that because of their numerous real-life connections, many measurement activities are naturally interesting and engaging for students and that it is not only helpful but appropriate to use such content, especially as students in grades 3–5 are expected to work more frequently with computational tasks involving length.

End of A Lengthy Story

How Many Ways?



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